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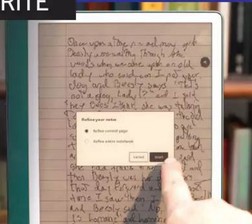

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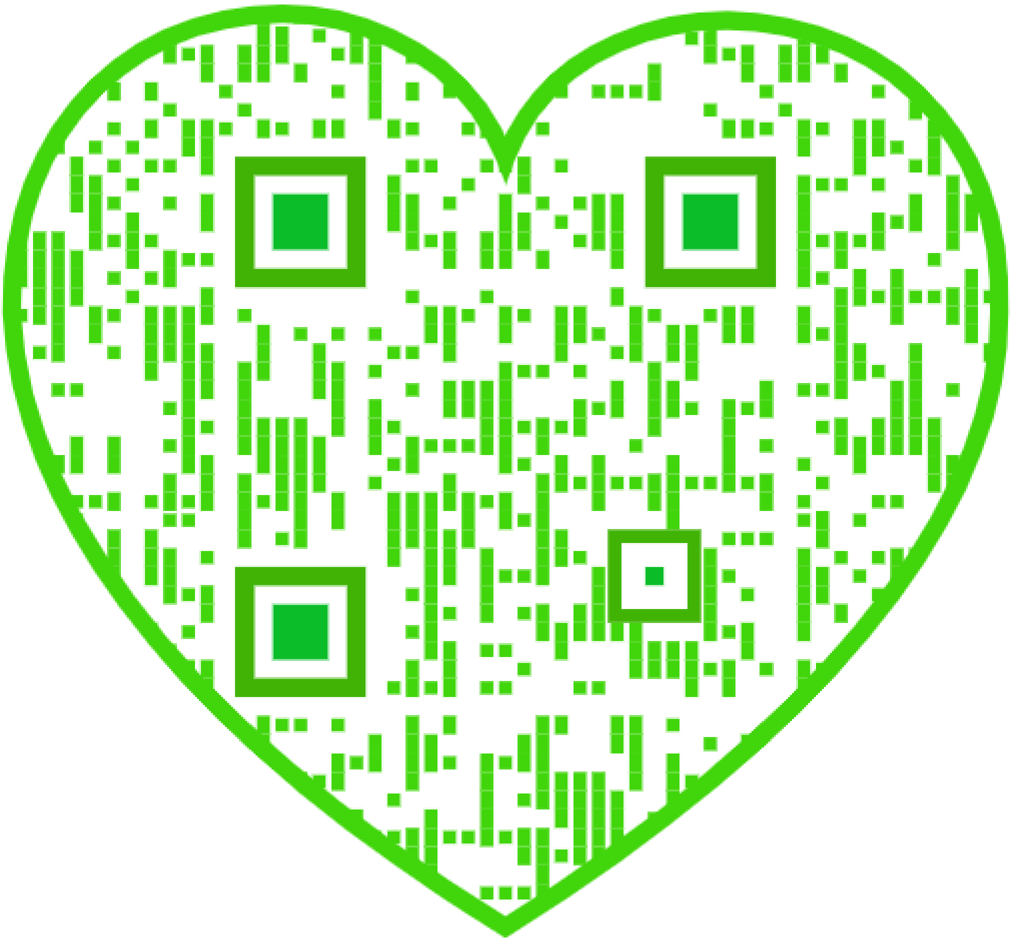

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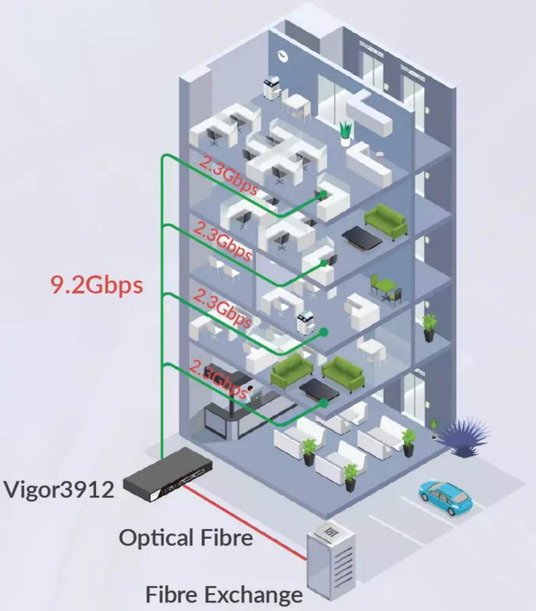

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Chips ahoy!

Rectangles of silicon to bring us joy

Wow. What an incredible start to the year! While 2024 was dominated by all things AI, this year is back in the game with the little things we love – chips! CES saw AMD, Intel and Nvidia announce new CPUs and GPUs, and by golly are they looking good. 2025 will also absolutely definitely be another astounding year in AI, and we'll be all over that, but today it's rectangles of silicon that we're excited about.

Nvidia stole the show. 2024 was a barren year for GPUs with very few new models, the cadence cycle being what it is, but things are storming now with an avalanche of CPUs and GPUs – with many more to come.

As I write I'm looking at the RTX 5080 and 5090 cards that have arrived in the Labs, with more coming. The guys are readying the business of benchmarking and opinion-forming and in our next issue we'll start publishing reviews. They didn't quite arrive in time to include in this issue, and the drivers Nvidia want us to use still haven't been made available to us as we go to press, and there's going to be a lot to digest as we put them to test.

Benchmarking will be interesting. Nvidia is boasting almost unbelievable gains over the last generation – for example claiming that the new mid-range 5070 will match or exceed the performance of last gen's top dog RTX 4090. But – almost all of that is due to the new DLSS 4 and its Multi Frame Generation feature. This magic generates three 'fake' frames per real frame, compared to 'just' one frame for DLSS 3. So, what we really want to know is what the actual rasterisation performance of the 50 series cards is (being the traditional raw performance of the card, sans magic), to see how much of a lift over the 40 series cards 50 series actually delivers. This is important because not all games will support Multi Frame Generation, so we need to be able to tell 40 series owners just how attractive the new cards are for all games.

The other issue is latency. Frame gen tends to muddy mouse and controller input. I personally can't play FPS games with frame gen on, the mouse just feels mushy and rubbery. Not nice for an elite gamer with mad skills such as myself. Nvidia has a new version of Reflex that was also announced, being its tech that tries to reduce latency (with varying success) and keep things responsive, but the proof will be in the playing so we shall see in the next issue of *APC*!

> "Benchmarking will be interesting. Nvidia is boasting almost unbelievable gains over the last generation"

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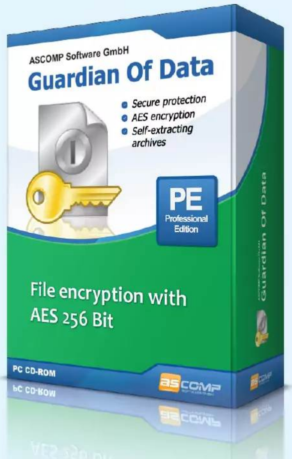

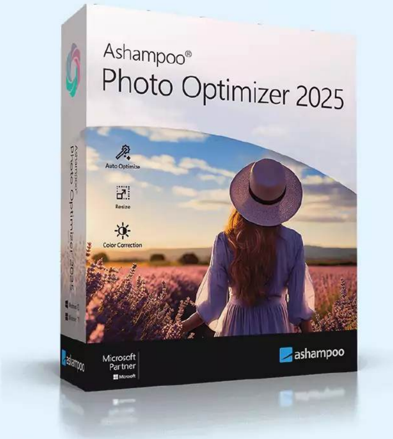

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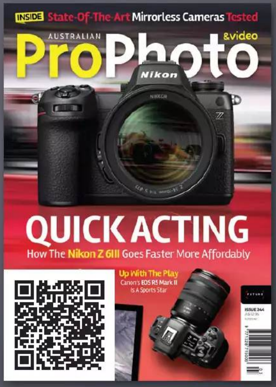
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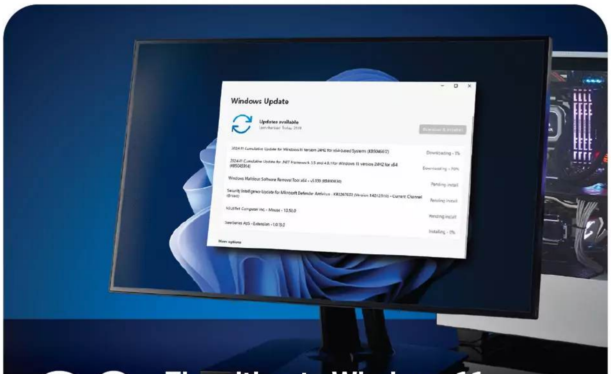
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> **“For a computer to claim the hypermiling crown I think we need to bring price into the equation. In short: how much is enough performance, and what’s the cheapest way of getting it?”**

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TECHNOTES

Everything you need to know from the month in tech

Nvidia announces the RTX 50-series

With more AI acceleration than ever, even the RTX 5070 is claimed to offer RTX 4090-level performance.

Nvidia kicked off its 2025 GPU announcements with the RTX 5070 at US$549 (Australian pricing hasn't been announced as we go to press). That will leverage AI in various ways to deliver, according to Nvidia, RTX 4090 performance for one third the price. It will also allow for higher levels of performance in laptops, with a mobile RTX 5070 using half the power of an RTX 4090 while matching it in performance.

The rest of the announced 50-series lineup consists of the RTX 5090 at US$1,999 as the halo part of this generation, with 3,400 AI TOPS of performance. The RTX 5080 will deliver a bit more than half the AI performance at 1,800 TOPS, with a far more attractive price of US$999 – inheriting the price of the outgoing RTX 4080 Super. The RTX 5070 Ti comes next at US$749 with 1,400 TOPS, and then finally the RTX 4070 with 1,000 TOPS at already noted US$549 price point.

It's an impressive start to the next generation GPU announcements, but we need to understand how Nvidia plans to deliver these upgrades. Given the stated AI TOPS of performance, the first thing to note is that Nvidia has doubled the AI compute operations relative to Ada Lovelace – at least for INT8 workloads.

Nvidia also showed "RTX Blackwell" offering 125 TFLOPS of FP32 graphics compute via the shaders, which is 1.5X more than its Ada generation counterpart, while the AI performance will be 3X as high. But that's for the full-fat GB202 chip, not for the trimmed down solution used in the RTX 5090. There could potentially be a higher spec RTX 5090 Ti or maybe even Titan down the line, or if not that, certainly there's the potential for a higher tier AI / data centre part using a fully enabled GB202 die.

What will Nvidia do with double the AI compute on all of its gaming GPUs? Naturally, it plans to have new features and software solutions that will take advantage of the capabilities. With the RTX 5070 offering 1,000 TOPS of compute, nearly the same performance as the RTX 4090 (1,320 TOPS) at one third the price, that opens the doors for more computationally demanding tasks.

This is likely all part of the DLSS 4 family of technologies, which were shown in a game demo during the keynote. Under the broad heading of "neurally rendered graphics," we saw various new technologies at work: DLSS 4, RTX Neural Materials, DLSS: CNN, DLSS: Transformer, Text-to-Animation, and RTX Neural Faces – all with full ray tracing,

Besides the desktop GPUs, Nvidia also announced the mobile lineup product names. There will be matching RTX 5090, 5080 5070 Ti, and 5070 laptops with availability in March 2025. While the model names match the desktop line, performance will be significantly lower, and we expect the other specifications will also see similar cuts.

The RTX 5090 laptop GPU will offer 1,850 AI TOPS. That means it's basically equal to the desktop RTX 5080. The mobile 5080 drops to 1,350 AI TOPS, slightly less than the desktop 5070 Ti. Mobile 5070 Ti will have the same 1,000 TOPS as the desktop 5070, and then the vanilla 5070 laptop GPU will offer up to 800 AI TOPS – which is probably a tease of the upcoming RTX 5060 Ti desktop part.

APC will have reviews of the first 50-series cards in the next issue.

NVIDIA 50 SERIES

	RTX 5090	RTX 5080	RTX 5070 Ti	RTX 5070
CUDA cores	21,760	10,752	8,960	6,144
Boost clock (GHz)	2.41	2.62	2.45	2.51
Base clock (GHz)	2.01	2.3	2.3	2.16
Tensor core TOPS	3,352	1,801	1,406	988
Ray tracing core TFLOPS	318	171	133	94
Memory	32 GB GDDR7	16 GB GDDR7	16 GB GDDR7	12 GB GDDR7
Memory bus width	512-bit	256-bit	256-bit	192-bit
Total Graphics Power (watts)	575	360	300	250
Required system power (PSU wattage)	1000	850	750	650
Power connector	1x 600 W PCIe Gen 5 OR 4x PCIe 8-pin adapter	1x 450 W PCIe Gen 5 OR 3x PCIe 8-pin adapter	1x 300 W PCIe Gen 5 OR 2x PCIe 8-pin adapter	1x 300 W PCIe Gen 5 OR 2x PCIe 8-pin adapter
Price (USD)	$1,999	$999	$749	$549

Nvidia

AMD unveils new gaming and AI chips

Ryzen AI Max series announced at CES 2025.

AMD kicked off CES with announcements for its Ryzen 9950X3D and 9900X3D processors. The Ryzen 9950X3D is a 16-core chip for gamers, using 16 of AMD's Zen 5 CPU cores, plus 32 threads. It also has a 144MB cache, including 128MB of AMD's 2nd Gen 3D V-cache.

The maximum boost clock is 5.7GHz and the TDP is 170W, an increase of 50W over the AMD Ryzen 9 7950X3D. AMD compared gaming performance of the 9950X3D and 7950X3D across 40 titles and claims an eight percent average improvement.

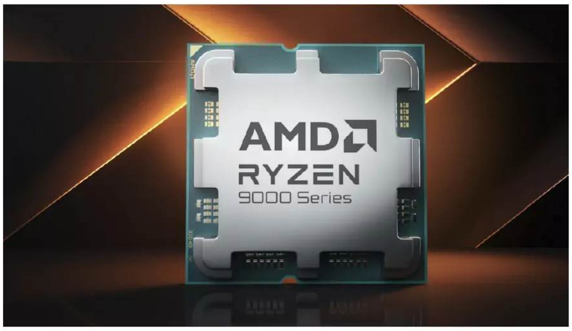
AMD has also introduced the Ryzen 9000HX Series for laptops. This includes the flagship Fire Range Ryzen 9 9955HX3D with 16 cores, 32 threads, a 144MB cache, and a maximum boost of 5.4GHz. incorporating AMD's Zen 5 architecture.

AMD is also releasing two non-X3D chips: the 16-core Ryzen 9 9955HX and 12-core 9850HX. The TDP of all three CPUs is 54W. Unlike the desktop series of processors, the company hasn't provided any benchmarks, nor a specific release date beyond the first half of 2025.

CES also hosted AMD's reveal of the Ryzen Z2 processor, designed for gaming handhelds. The Z2 Extreme features four Zen 5 cores and Zen 5c cores, plus 12 RDNA 3.5 graphics cores, and a max boost of 5.0GHz. The two other chips, the Z2 and Z2 Go, will have eight and four cores respectively, both offering 12 graphics CUs, but the Z2 Go is based on older Zen 3 hardware and RDNA 2 graphics.

An AMD spokesperson claimed that the Z2 series would be "coming to market from a number of partners", including the ROG Ally and Steam Deck. A Valve representative has since clarified that there will be no new Steam Deck based on the Z2.

> "An AMD spokesperson claimed that the Z2 series would be "coming to market from a number of partners", including the ROG Ally and Steam Deck."



AMD, Intel

intel
CORE
ULTRA

Intel launches Arrow Lake mobile family

Core Ultra 200HX and 200H processors for laptops.

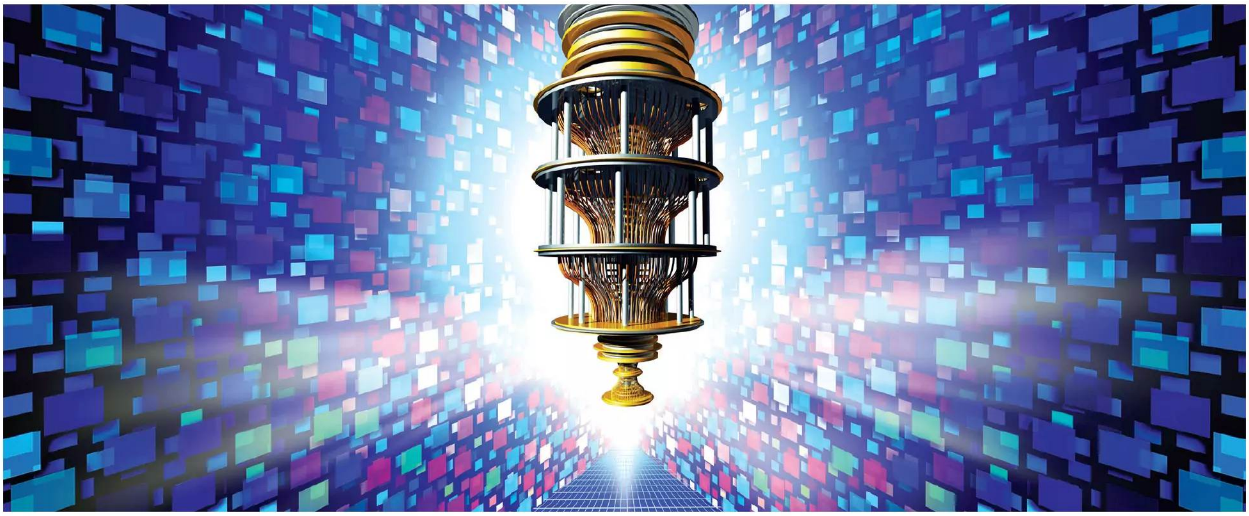
Intel launched its Arrow Lake mobile product stack here at CES 2025 in Las Vegas, announcing five new Core Ultra 200H series processors for mainstream high-performance thin-and-lights, and six new Core Ultra 200HX series models for laptops. The 200H series slots in as the mainstream performance-focused portion of the company's Core Ultra 200 series, while the 200HX models serve as desktop/workstation replacements for enthusiasts by employing the same silicon the company uses for its desktop PC processors. Intel's previously launched Core Ultra 200V Lunar Lake processors will continue to serve as the battery life champs for Intel's laptop silicon. However, neither of the new processor families meet the minimum AI performance requirements from the NPU to meet Microsoft's certification for CoPilot+ PCs, leaving Lunar Lake as the company's only CoPilot+ capable platform.

The entire Intel Core Ultra 200 series is a complicated affair with multiple different tiers and architectures, here's a breakdown:

- **Intel Core Ultra 200H: Arrow Lake mobile for mainstream segment**
- **Intel Core 200H: Raptor Lake**
- **Intel Core Ultra 200HX: Arrow Lake mobile for enthusiast/commercial**
- **Intel Core Ultra 200V: Lunar Lake for low power segment**
- **Intel Core Ultra 200U: Reportedly Meteor Lake Refresh**
- **Intel Core Ultra 200S: Arrow Lake for desktop PCs**

The Core Ultra 200H series processors with integrated graphics will launch in early Q1, and the Core Ultra 200HX series systems with discrete graphics will follow in late Q1 due to the release timing of a new family of discrete GPUs. Intel will also launch its VPro Lunar Lake models in early Q1.

> "The 200H series slots in as the mainstream performance-focused portion of the company's Core Ultra 200 series, while the 200HX models serve as desktop/workstation replacements for enthusiasts."



Post-quantum cryptography

Is all our sensitive data about to be blown wide open? Steve Cassidy asks himself how quantum changes the game.

So what's the connection between quantum and cryptography?

Quantum computing is a tricky topic, but you can think of it like this: in a quantum computer, a single bit of data can represent both zero and one simultaneously. These magical registers are called qubits, and if you stack a lot of them together you can perform mathematical operations on millions of different values at once – and then use probabilistic analysis on the results to extract the answer you're looking for.

And the connection to code-breaking?

Many mainstream cryptographic systems are asymmetric. They rely on the fact that it's quick and easy for a computer to multiply two prime numbers together, but much more time-consuming to reverse the operation and find the prime factors of a given number. In fact, the fastest computers we have today would take trillions of years to crack a 2,048-bit RSA encryption key. Quantum computing changes the game: it's estimated that a quantum computer working with 20 million qubits could crack the same encryption key in just eight hours.

Is this a real problem? Does anyone actually have a quantum computer that powerful?

Right now, the biggest quantum computer in the world is IBM's Condor, which comprises 1,121 qubits – so you don't need to panic just yet. However, the field is advancing quickly, and cloud-based quantum services are already widely available from Amazon, IBM, Microsoft and others. Computer scientists live in anticipation of "Q-day" (flippantly known as "Y2Q"), when quantum computing reaches the point that existing asymmetric cryptographic methods are effectively useless. Some attackers are already preparing for that day by stockpiling stolen data that can't currently be decrypted, but which could one day be broken open to reveal valuable secrets.

So should we work on the basis that cryptography is already dead?

Things aren't quite that bad. While cryptographic algorithms that rely on asymmetry are on their way out, there are other approaches that are much less susceptible to quantum cracking. One such model is symmetric encryption, as used by the AES algorithm. This encodes and decodes data using an arbitrary key that can't be mathematically derived, so attackers can't use quantum computing to help them break it. However, symmetrical encryption introduces the new challenge of finding a secure way of exchanging the encryption keys.

And research is ongoing into other quantum-resistant mathematical methods that could replace today's widely used algorithms, such as lattice- and hash-based cryptography. Quantum-proof encryption is already built into some popular tools that emphasise security and privacy, such as iMessage, Signal and NordVPN, and is becoming more widespread.

How can I be sure that I'm using an encryption system that's not quantum-vulnerable?

There's no easy way to verify for yourself that a given algorithm won't be vulnerable to quantum cracking in the future, but you can get some reassurance by keeping an eye on big businesses such as banks and tech giants. When they abandon an encryption standard, you'll know the danger is real. And it's a good bet that whatever system they move to will be safe from quantum attacks, because they have the resources to verify that for themselves – and every incentive to get it right. ■

> "Right now, the biggest quantum computer in the world is IBM's Condor, which comprises 1,121 qubits – so you don't need to panic just yet."

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Tech and social media is rushing to adjust to a new Trump era

Mark Zuckerberg's new Meta social media policies are just a portent of dramatic changes to come, writes Shaun Prescott.

The new year kicked off with Donald Trump's second presidential inauguration and along with it, a whole lot of pragmatic but nevertheless embarrassing corporate kowtowing. Amazon, Meta, Google, OpenAI, and reportedly Apple's Tim Cook, all made generous donations. None did in 2017.

Whereas Trump's 2016 election victory might have seemed like a dark aberration, his second victory marks an irreversible change for America and thus the world. Tech billionaires know this, and are rushing to adapt to the new conditions.

The most obvious example came via Meta. Wasting no time, the company announced sweeping changes to its content moderation policies the day after Trump's inauguration. Third party fact-checking will cease, and crowdsourced fact-checking (similar to the Community Notes on Twitter / X) will commence. Restrictions will be lifted on a range of previously restricted topics that are "part of the mainstream discourse", including "immigration, gender identity and gender", with most moderation efforts focusing on illegal material.

Zuckerberg appeared on the Joe Rogan podcast in the days following the announcement. Among other things he certainly wouldn't have said three months ago, he spoke of the need for more "masculine energy" in tech corporations. I don't really know what masculine energy in this context means, but it's fair to say Zuck would have been pilloried for saying this in mid-2024.

The real difficulty I have with Zuck's new content policies is how they seem to be heavily inspired by Elon Musk's X, which during the course of 2024 turned into something more akin to 8Chan. Anyone brave enough to tab over to the "For You" feed is likely to be met with egregious engagement spam, reams of AI churn, racial slurs, and boorish right wing influencers like Ian Miles Cheong and Richard Hanania. Even Milo Yiannopoulos is back (remember him?).

Disinformation is a problem too, though as Zuckerberg notes in his interview, its definition can get murky. What Zuckerberg knows but fails to emphasise, is that disinformation can also be real and unambiguous. Propaganda of mysterious provenance is rife on X. Facebook took steps to fight this force during the early 2020s (mostly at the behest of the US government) but the platform is likely to devolve yet again into an endless stream of radicalised uncles.

Tech companies launder their disinclination to invest in moderation with the good ol' freedom of speech argument. Obviously, when the first amendment was ratified in the late 18th century, social media did not exist. The utterance of a single person was exceedingly unlikely to be heard globally. I mean, the difference between then and now doesn't need much explanation.

The truth is that Zuckerberg and his contemporaries don't care about so-called freedom of speech. What they want is your data, which – on the blandest level – can be used to fine-tune advertising algorithms. They are also more potently aware than ever that social media platforms are powerful political tools. While that has been true for a decade now, Elon Musk has emphatically proven that buying a platform and comprehensively reshaping its policies can result in seismic political consequences. Now that the paradigm has shifted away from respectability, the platforms are likely to sour – but probably not to the detriment of their power and profitability. ■

> "What they want is your data, which – on the blandest level – can be used to fine-tune advertising algorithms."

Shaun Prescott is an Australian editor for PC Gamer, GamesRadar and PLAY, and writes for APC, TechRadar and more.

Gelsinger says goodbye, again

Battered and bruised on all fronts, Intel needs to change.

Pat Gelsinger has retired as Intel CEO.

Pat Gelsinger voluntarily 'retired' from Intel on December 2, 2024. There are rumours that he was effectively pushed out the door – that Intel's board of directors wanted him out, and had lost confidence in his ability to effectively lead the company back to profitability.

Certainly, Intel's stock price has taken a beating over the past few years, though it was obvious when he took the reins that the company needed to make some major changes. With the unexpected announcement, Intel's stock took a further hit, and dropped 15 percent in the following days, but that pales when compared to the 64 percent decline of the past three years and ten months.

The problems Intel faced haven't changed much. It fell behind on process node leadership after 2014, and Gelsinger's plan to release five new process nodes in four years hasn't fully materialised. He also pushed for opening up Intel's fabrication facilities with Intel Foundry Services (IFS). There have been a few customers, but so far none have been particularly noteworthy. Intel 3 has only seen use for Intel's own Xeon 6 processors, and the Intel 20A node was cancelled in September 2024, ostensibly because Intel 18A was ahead of schedule, and the short-lived 20A node was deemed an unnecessary expense.

Gelsinger said at the time that the 18A defect density was already below 0.4 def/cm2 (defects per square cm), a key measure of viability. But Broadcom later reportedly said that 18A wasn't fit for HVM (high volume manufacturing), and pundits began talking about sub-10 percent yield rates for 18A. That was faulty reasoning, based on full-reticle sized chips without defect.

A near reticle-sized chip would only get around 65 chips per wafer, and with a 0.4 def/cm2 defect density that would work out to around only five fully functional chips. But large and fully functional chips are problematic to begin with, which is why Nvidia, Broadcom, Intel, AMD, and others build in redundancies, along with the ability to turn off faulty portions. It's why, as an example, Nvidia's Hopper H100 – an 814 mm2 chip, where the maximum reticle size is 858 mm2 – only has 132 out of a potential 144 Streaming Multiprocessors enabled.

But only Intel and its closest partners can say for certain how things are shaping up with the 18A process. It's the node that was supposed to "regain process node leadership" from TSMC, according to Gelsinger's 5N4Y plan. TSMC, meanwhile, continues to move toward HVM for its 2nm-class node. More importantly, TSMC continues to be the top contract foundry for other companies looking for state-of-the-art manufacturing.

There's speculation that Intel may be looking to spin off its foundry division as a separate entity to make Intel Foundry Services more competitive with TSMC and Samsung. That was another one of the rumoured sticking points, and the permanent CEO replacement will likely say a lot about how the board is leaning.

For his part, Gelsinger tweeted that he's "proud of the TD/18A team for the incredible work and progress they are making." Next year represents a critical inflection point for Intel, currently without an official head. Even if 18A works well, Intel needs large customers committed to using its foundries. It could take several more years for that to happen, and Intel will need to continue to execute on any future plans. Whether it can successfully do so remains to be seen. ■

> "The problems Intel faced haven't changed much. It fell behind on process node leadership after 2014, and Gelsinger's plan to release five new process nodes in four years hasn't fully materialised."

Jarred Walton has been a PC and gaming enthusiast for over 30 years.

It’s not all bad news

Intel’s new graphics card is what the market needs.

When intel first announced the new Arc B580 graphics card, I was disappointed. It wasn’t the Nvidia RTX 4070 killer I’d been hoping for. But the more I think about it, the more I realise I was seeing it through the lens of an enthusiast. The thing is, most people don’t spend even $1,000 on a graphics card, so the $500 price of the B580 is actually bang on.

The Intel Arc B580 and its new Battlemage architecture gives you a lot for just $500. Even Intel isn’t claiming the B580 can compete with a $900 RTX 4070, but it is claimed to have the measure of the 8GB Nvidia RTX 4060 in both traditional raster games and with ray tracing, and even when the 4060’s 8GB of memory isn’t a direct limitation.

Notably, that 192-bit bus and the 12GB of VRAM means the B580 ought to hang together much better at higher resolutions like 1440p, particularly in the latest games and when ray tracing is enabled. The latter is typically very memory intensive.

To be clear, I’m writing these words after the B580 has been announced but before the embargo has lifted on reviews. I can’t comment directly on its performance outside of Intel’s claims, but the numbers Intel is quoting look plausible for the specification of the GPU and card. If they play out in reality, it will be one heck of a GPU for the money.

It’s not just the pure 3D performance of the B580 that makes it appealing; it’s the technology and features. Intel did an impressive job with ray tracing with the original Arc graphics cards and the B580’s RT units are said to be anywhere between 1.5 times and two times faster, depending on the specific workload.

Intel was arguably already doing a better job at ray tracing than AMD, and the Battlemage architecture promises to move the game on further and match or beat Nvidia’s Ada Lovelace generation of GPU design, although Nvidia will have its new architecture ready early in the new year.

What’s more, Intel is rolling out a new second-gen upscaling platform known as XeSS 2. Like Nvidia, Intel uses AI acceleration cores – in Intel’s case known as XMX cores – to power its upscaling technology, where AMD relies on hand-coded algorithms running on the shader cores. The original XeSS was already better than AMD’s FSR in many ways, and I’d be surprised if XeSS wasn’t better still. Oh, and Intel is adding frame generation and low-latency features. In fact, Intel really is showing AMD up with its features and tech on the B580. AMD still doesn’t have any AI cores in its gaming GPUs, for example.

What you’re getting with the Arc B580 is a modern, full-feature GPU with great specs at the price we’ve all been begging for. Surely there’s a catch? If there is, it’ll be drivers. Driver quality for the first-gen Intel Arc cards was dire.

But Intel’s gaming graphics spokesperson, Tom Petersen, says the drivers for the new Battlemage-based B580 GPU suffers from “no known issues of any kind.” That’s one heck of a claim, but I hope it’s true. Because if it is, the B580 is the sensibly priced graphics card we’ve all been crying out for. ■

intel
ARC
B580
intel
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ARC

Intel’s new B580 isn’t the graphics card we were expecting, but it could be what we actually need.

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Six raw 4K panels for breakfast, laced with extract of x86...
Jeremy Laird eats and breathes PC technology.

Extreme budget computing

Ignore the hype around the Pi 500, says Jon Honeyball, and enjoy the hypermiling instead.

It's called hypermiling in the motoring world: squeezing the most distance you possibly can from the minimum amount of fuel. In the computing world, we only used to think about absolute performance. There was never enough, and let's ignore the power consumption. Today, with the help of Moore's Law and greater environmental consciousness, we have moved on. Now I want maximum performance with minimal energy use. The crown appears to sit with Apple's quite extraordinary M4 family of processors, which offers eye-watering performance with power consumption that's almost laughably low.

But that's on a computer which, when you add in all the "extras" like screen, keyboard and mouse, costs a lot of money. It wins for efficiency after you've bought it, but for a computer to claim the hypermiling crown I think we need to bring price into the equation. In short: how much is enough performance, and what's the cheapest way of getting it?

So I present to you my new computing hypermiling king, the Raspberry Pi 500. This updates the also marvellous Pi 400 with a Pi 5 processor board, so you're buying a computer that includes everything you need built into the keyboard unit. Well, almost everything. Raspberry Pi has also launched a screen, called the Raspberry Pi Monitor, which will do produce a perfectly reasonable 1080p image on its 15.6in IPS display. Naturally, there is a fully adjustable monitor mount for this too, if you want to lift it off the tabletop.

The cost? Well, the Pi 500 is $159. The screen is $188, and the Pi Mouse is $21.70. And here is the dilemma. It is actually all you need on a day-to-day basis to do normal home computing. I haven't looked at Pi as a desktop OS for a while, but last time's outing was very positive. A quick search shows that LibreOffice is available, which is of course free and does everything anyone actually needs in an office suite.

Frankly, it's all you need for most normal business computing too, if everything runs within cloud services such as Google Workspace or Microsoft 365. You don't get the full integrated management stack of the new Microsoft Windows Link device, but I'm sure I will have no problems locating an appropriate RDP client on the Pi 500 and thus have access to a fully cloud-hosted Window 365 session.

If you are an SME, then what's stopping you? Surely this is enough computing resource you need, and at both an energy and price hypermiling point that cannot be ignored.

Of course, I would rather use my new M4 Pro Mac mini attached to its Apple 5K screen. I would rather have access to pro-grade tools like the Adobe suite, Final Cut Pro, Logic Pro, full-fat Microsoft Office and every other bauble and fun toy. But we must step back and ask the question: what do you actually need? And what price are you prepared to pay to get those additional capabilities?

Now that I've ordered a Pi 500, I'm tempted to give myself the task of using it as my daily driver. I'm not sure how long I will last, given my reliance on advanced capabilities within Excel, but as a second screen on my desktop, and most especially as a computer in my work room at home, the hypermiling king will surely reign supreme. ■

> "For a computer to claim the hypermiling crown I think we need to bring price into the equation. In short: how much is enough performance, and what's the cheapest way of getting it?"

Jon prefers "inexpensive" to "cheap".

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AI agents: putting AI to work

This year is set to be all about AI agents. Nicole Kobie reveals what this means and whether the backlash is beginning before AI agents are even here.

Hey, assistant! I sent you a link to a form. Can you dig out the sales figures from last month in order to fill it out? I'll be at lunch, so message me any questions."

Such dull jobs used to be saved for junior staff and interns, but soon AI may be taking them on – well, that's the promise of AI agents, according to those developing the smart automation tools.

It's high time for AI to start proving useful, as various surveys suggest a third of businesses continue to be too scared of the risks to consider implementing the technology (Indeed), seven in ten employees aren't convinced it makes them more productive (Resume Genius), and a Goldman Sachs report suggested the benefits remained too little given the costs.

That's why AI developers – Google, Microsoft, OpenAI and Anthropic, among others – are beginning to release details about their own AI agents, sparking predictions that the digital helpers will be the big story in 2025. Microsoft and Anthropic have already launched agents, Salesforce believes its customers will have a billion agents in use by 2026, and OpenAI chief product officer Kevin Weil said in October: "These more agentic systems are going to become possible, and it is why I think 2025 is going to be the year that agentic systems finally hit the mainstream."

But warnings are already sounding on security risks, poor performance and employee trust, while analyst house Gartner says there's a risk that companies will be overwhelmed by agents that no-one can remember the purpose of – similar to the problems raised by creating too many bots in robotic process automation.

The AI industry seems dead set on making this pivot to agents, so here's what we know, how it will impact you, and how they're already being used.

AI agents vs agentic AI

So what is an AI agent or agentic AI? Well, that depends who you ask. Some see the idea as merely letting AI loose in the real, if digital, world, with software that can read documents, type text and click links. Given that's what many of us spend our working days doing, giving a large-language model such skills could mean the technology gains real capabilities.

Others believe that AI agents should have, well, agency – or at least the ability to make decisions. Arguably, if a piece of software needs to read a website, understand that information, and apply it when choosing which button to click, that could be seen as making decisions.

Krishna Tammana, chief technology officer of customer engagement developer Gupshup, explains that agentic AI is different from conventional, narrow AI that may be designed for specific tasks and require plenty of human oversight or intervention. AI agents have autonomy and context, extending their powers.

"Agentic AI is a type of AI that operates autonomously, capable of pursuing complex goals and workflows with minimal direct human supervision," said Tammana. "At its core, agentic AI aims to function similarly to a human employee by understanding context and instructions in natural language, setting appropriate goals, reasoning through subtasks, and adapting its actions based on changing conditions."

There are some who differentiate between AI agents and agentic AI. "We see agentic AI as an autonomous decision-making capability that can act independently within defined parameters, allowing enterprises to delegate operational decisions that do not need oversight but still prioritise ethical standards, data integrity, and security," said Manoj Chaudhary, CTO of Jitterbit. "This approach ensures that businesses can achieve efficiency and innovation without compromising on accountability and control."

Chaudhary added: "AI agents, on the other hand, are task-oriented for predefined actions and follow specific user commands to automate workflow management, assist in complex development tasks, and provide real-time decision-making support. These agents offer immense potential to improve key areas of business process management with orchestrated oversight, including workflow automation, resource allocation and performance monitoring."

Now, it's worth noting that some in the industry are widening the definition of AI agents to include any form of automation or interaction, including chatbots and transcription. What's more, the idea of AI making decisions and doing things inevitably raises the spectre of artificial general intelligence (AGI) rising up to take our place as the supreme beings on the planet. But it's worth keeping a narrow definition of AI tools that can take action – otherwise, it's just plain old AI.

What's on the horizon

The big players all have equally big plans for AI agents in the coming year.

OpenAI's CEO Sam Altman has said that 2025 is the year that "agents will work", with the company showing off a demonstration of an agent making a voice phone call to place an order. A Bloomberg report said insiders at the company discussed OpenAI's agent plans at a staff meeting, suggesting the company plans to unveil its version called "Operator" in January 2025.

Microsoft unveiled its own first take on agents in Copilot in October, highlighting how early adopter customers used the tools to quickly develop bespoke automated tools to triage emails and track expenses. Charles Lamanna, CVP for Business & Industry Copilot at Microsoft, said that the tools can help augment business processes and workflows. "They're able to work on behalf of a system as opposed to a person, work asynchronously, or even autonomously to complete tasks," he stated.

Anthropic, a rival AI firm formed by ex-OpenAI staffers, has already unveiled a very early AI agent as part of an update to its model, Claude. In a post on the Anthropic website, the company said that "developers can direct Claude to use computers the way people do – by looking at a screen, moving a cursor, clicking buttons, and typing text". However, the company added that the "computer use" tool is still experimental – and prone to errors.

What's next? Gupshup's Tammana is bullish on the potential progress for AI agents. "The trajectory of agentic AI will see rapid advancement, with increasing sophistication expected in the next 12-24 months," he said. "While not yet perfect, these AI agents represent a transformative technology that is progressively becoming more reliable, versatile and integral to complex problem-solving across industries."

As always, we'll have to wait and see how far these tools develop, but with AI agents such a clear focus for the industry we can be certain that plenty of money will pour into development. With so much competition, we expect progress to be rapid.

How could we use agents?

We keep being promised that AI will take over the dull, routine tasks that prevent us from digging into the creative, interesting bits of our jobs. By linking company data with an LLM in an organised way, an agent can do this – or at least some of this.

"By automating routine cognitive tasks, these technologies dramatically reduce operational costs, enable faster decision-making and allow human employees to

INTRODUCING
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OpenAI's Operator agent is likely to be launched in early 2025.

focus on higher-value, creative work," said Gupshup's Tammana. "Companies can leverage AI agents to process complex data sets, generate comprehensive market analysis, develop sophisticated predictive models and create strategic recommendations with speed and precision previously unattainable."

The use case for AI agents naturally differs by sector. In healthcare, Tammana says, such agents could continuously watch patient data to recommend interventions, while in financial services, AI agents could be set to work in fraud detection, looking for unusual patterns of behaviour. In HR, AI agents can sift through CVs, schedule interviews and even conduct first-pass assessments, while in retail such tools can offer personalised recommendations and manage inventory.

AI agents at work – now

Andrew Filev, CEO and founder of Zencoder, says that boring, mundane or administrative tasks are good candidates for agentic AI – and that includes some, but not all, aspects of software engineering. "For example, when engineers create software systems, part of their work is highly creative, part is intellectually hard, and part is quite routine. In any large project a lot of engineering time goes to routine bug-fixing and maintenance, which consists of fixing a lot of smaller issues."

Filev says that AI coding agents can already handle between 5% and 10% of those smaller issues, predicting that will increase above a quarter by the end of 2025. That can be further extended to another 60% of smaller issues by breaking those down into smaller tasks, guided by human feedback, he adds.

To be clear, that means the vast majority of routine coding work such as bug fixing and maintenance could in theory be partially automated, but not the rest of coding. That doesn't mean software engineers will lose jobs.

"Most software companies go through a painful budgeting process, where they have to cut a lot of features from the roadmap because of the resources required to fix the bugs and maintain existing solutions," Filev said. "In my decades of experience, I have never met a software company that didn't have to prioritise the features and cut something out. AI coding agents have the potential to offload some of the bug-fixes, allowing the companies to execute on more of those innovative ideas, which would make user experience better, developer experience better and the company more competitive and innovative."

That's coding. Peter Wood, chief technical officer at Spectrum Search, says the company recently started using an AI agent in recruitment, in particular for data-heavy tasks such as analysing trends and matching candidates to roles. "It's all about cutting through the noise – things that would take a person hours, or even days, to process, this little marvel can handle in seconds," he said.

Rather than buy in a solution, the company opted to build its own – and it took time. "Testing it was like teaching a very clever toddler – lots of patience and trial runs with anonymised data," he said. "We started small, ironing out quirks before gradually introducing it to the wider team."

Wood adds that there was initial pushback from human employees. "Honestly, there were a few raised eyebrows from staff at first – who wouldn't be wary of a robot 'helper'? – but when they realised it wasn't there to nick their jobs, just make them easier, it won most people over."

There have been challenges, including edge cases that Wood says "stumped the system", but overall the AI agent has improved the speed and accuracy of dealing with customer requests.

Be wary

Those examples highlight some of the upsides. And there are downsides – beyond the obvious one that many of these claims and technologies remain largely unproven and unverified, especially beyond the tech-savviest of companies.

"For anyone considering AI, I'd say this: it's not a magic wand. You still need strategy, training and a clear purpose," Wood added. "Oh, and don't skip the ethics. AI is powerful, but making sure it's fair, unbiased and respectful of privacy is non-negotiable."

"Data privacy and security are crucial considerations, as AI agents may have access to sensitive information," agreed Zencoder's Filev. "Proper governance and ethical guidelines must be put in place to ensure that AI agents are used responsibly and do not cause unintended harm. Additionally, companies should invest in training and upskilling their employees to work alongside AI agents effectively, rather than viewing them as a replacement for human workers."

Implementation won't be easy. And though a bespoke AI agent may work well for a software developer, it could be beyond the capabilities of a small marketing boutique. And these systems aren't cheap, so keep a close eye on promises about return on investment. All of that means that AI agents may not be for everyone.

"Practical challenges include the complexity of integrating agentic AI into existing enterprise systems, which can be time-consuming and technically demanding," added Tammana. "The computational resources required for training and running these advanced systems can also be prohibitive for some organisations."

If a bit of investment saves your staff time and frustration, AI agents may prove worth it. If they initially prove more trouble than they're worth, you'll be glad to have waited for the second wave of AI agents.

So when it comes to AI agents, although AI leaders are saying 2025 is the year they go mainstream, patience may be a wise move. Though marketing materials and business consultants will urge companies considering AI agents to act now to avoid being left behind, it's worth watching to see how these technologies actually play out – and whether they pay off.

In the meantime, maybe keep the intern around, but stay tuned, things are about to get very interesting. ■

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Mac Mini (2024)

It shouldn't be a big story that a desktop computer has upgradeable internal storage, but with Apple's cute new 2024 Mac mini, that's exactly where we are. It's possible to pop the SSD out after removing a screw, and then switch in a bigger one. But there is a catch.

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- 10-core GPU with hardware-accelerated ray tracing
- 16GB RAM, 256GB storage
- Front: Two USB-C ports with support for USB 3 (up to 10Gb/s), 3.5mm headphone jack
- Rear: Three Thunderbolt 4 (USB-C) ports with support for Thunderbolt 4 (up to 40Gb/s)
- WiFi 6E, Bluetooth 5.3

KEY FINDINGS

- Apple has always charged over market price for Mac memory and storage upgrades, but historically this wasn't a big issue. RAM and SSDs used to be commodity parts, so you could just buy the minimum spec from Apple, and order upgrades at a lower price from another source. Then, Apple started soldering things to the main board, and with Apple Silicon, everything – RAM, storage, GPU – was integrated.
- The new 2024 Mac mini still has soldered-in RAM, as is the new norm with the Unified Memory architecture, but the SSD can be swapped out, and we have upgraded a 256GB drive to a 512GB using the Apple Configurator tool. We also swapped like-for-like 256GB drives between two base models.
- We're off to a good start, but here come the catches. First, the Mac mini's storage is non-standard. Although it looks similar to an M.2, it's nothing you can just buy off the shelf and use, like for most Windows and Linux desktop (and many laptop) PCs. However, the fact that the parts are modular means that in the future, there could be a ready supply of used parts from other Mac minis. The lack of a software lock makes the prospect of aftermarket parts look pretty good.
- The new, smaller 5×5-inch Mac mini has a cooling system where the circular bottom grille is used both for pulling in cool air at the front, and ejecting hot air at the back. The air is routed through various layers to cool them.
- The power supply unit itself (which, admittedly, is a work of art) is no longer encased as a module, but instead sits bare at the top of the sandwich, right beneath the Apple logo. Apple pointed out in its press materials that this puts the power circuitry above the computer parts instead of below them, which stops the SoC from getting an extra toasting. And, since the main cooling happens near the base, the hot SoC gets first dibs on cool air.
- The new Mac mini has modular front-facing ports. Cool! Those two USB-C ports, along with the headphone jack, can be removed and replaced individually without soldering. The rear ports are all soldered, though. We'd prefer all the ports to be modular, but as the front ports will be subject to more wear and tear, this is at least a sensible compromise.
- Repairability Score: 7 out of 10 (10 is easiest to repair). The standout feature is clearly the user-swappable storage, but this is only useful if Apple makes it easy for us to buy replacements. We also want to see the same thing in Apple's portables. After all, it's easy to plug a big external SSD into a desktop, but a hassle to add storage to a laptop. In all, though, the new Mac mini typifies Apple's repairability path – it's moving in the right direction, if slower than we'd like. ■

Even the base M4 chip is incredibly powerful, and probably provides all the performance most users will ever need.

The use of efficient Apple silicon makes it possible to have sufficient cooling in such a tiny box.

The Mac mini is still highly integrated, so there's no chance of replacing the CPU or RAM.

The new Mac mini's SSD is removable. But does that mean it's fully upgradeable?

Find the best deals
on new gear at
getprice.com/au

The A-List

The best products on the market, as picked by our editors.

Premium laptops

Apple MacBook Pro M4

ONE OF THE BEST LAPTOPS THAT'S EVER BEEN MADE.

This M4 update to the already brilliant MacBook Pro line is an easy recommendation, so the big question becomes do you choose the 14in version or 16in. But whatever you choose should last for years, and look great while it's doing it.

From $2,499, apple.com/au

THE ALTERNATIVES

ASUS ZENBOOK DUO
A dual-screen laptop that uses a practical layout and excels at everyday use. The unique form factor is incredibly handy for those who need dual screens on the go.
$3,999, asus.com

APPLE MACBOOK AIR
The MacBook Air M3 replaces the M2 model previously listed here. It's a powerful and quiet ultraportable with an unbeatable battery life and screen.
From $2,099
apple.com/au

MICROSOFT SURFACE LAPTOP 7
A shining example of just how good a Windows laptop can be. Despite a few minor drawbacks, the Surface Laptop is a fantastic package that offers performance and battery life.
$1,899, microsoft.com

Business laptops

HP OmniBook X

THE QUALCOMM CPU REALLY DELIVERS.

The latest Qualcomm CPU helps create a standout laptop that will impress compared to Intel powered alternatives. The OmniBook X has been on sale across all major retailers for $2,079. At this sort of price the X is the cheapest Snapdragon X Elite laptop going, and a compelling buy.

From $2,079, hp.com

THE ALTERNATIVES

DELL LATITUDE 7340
This 1.1kg laptop offers terrific battery life and, if you choose the better non-touchscreen (look for 400 nits of brightness in the specs).
$2,475
lenovo.com/au

ASUS ZENBOOK S 16
The Asus Zenbook S 16 offers premium performance in the ultraportable category and competes well with alternatives such as the Surface Laptop 7 or Macbook Pro.
$3,499, asus.com.au

LENOVO YOGA 7I AURA
The Lenovo Yoga Slim 7i Aura is a sleek, versatile laptop with a great display, excellent build quality, and solid performance, and is an especially good buy when on sale.
$2,799, lenovo.com /au

Gaming laptops

Alienware m16 R2

A PREMIUM AND AFFORDABLE GAMING & WORK MACHINE.

There are cheaper gaming laptops, and faster ones too, but we love the balance offered by the m16 R2. Who doesn't want a big 16in gaming laptop, featuring a Ultra 9 CPU, a RTX 4070 GPU and 32GB of RAM? And for a decent price, considering it's from Alienware.

$3,300, dell.com

THE ALTERNATIVES

LENOVO LEGION 5I
Best in class performance from the powerful RTX 4070 GPU and stand out features such as 140W PD charging.
$3,499
lenovo.com/au

ACER NITRO V 16
It's a cheap and cheerful gaming laptop, but that's exactly what the Nitro V series does best, and overall this new 16in model offers great bang for buck.
$1,500
store.acer.com

NEW

MSI TITAN 18 HX A14V
A wallet-busting powerhouse that pushes the limits of gaming laptops. The MSI Titan 18 HX offers unmatched power and luxury.
$8,599
au.msi.com

Everyday laptops

Asus Zenbook S 13 OLED

ASUS AND INTEL TEAMED UP TO BUILD A MACBOOK AIR KILLER.

A compact and budget friendly Ultrabook that's the best available device for many on-the-go professionals. Compared to the MacBook Air 13, it has an additional HDMI and USB-A port, an SSD that's roughly twice as fast, and the screen is brighter and offers rich OLED contrast.

$2,099, asus.com

THE ALTERNATIVES

ACER SWIFT 14 AI (INTEL)
The Acer Swift AI 14 is a great overall package, and while the $2,399 RRP feels steep, we've seen it discounted to $1,800, making it an excellent buy.
$2,399
acer.com

APPLE MACBOOK AIR 15
An awesome plus-size MacBook Air with great battery life and graphical performance. GPU performance and battery life are the standout perks here. **From $2,199**
apple.com/au

LENOVO YOGA SLIM 7X
This is almost everything we could want in a Windows laptop, and offers a compelling mix of features, strong performance and amazing battery life.
$2,909, lenovo.com

Chromebooks

NEW

Asus Chromebook Plus CX34

A sleek and relatively affordable ChromeOS workhorse, the Asus Chromebook Plus CX34 delivers strong performance and features at a competitive price when on sale, and is ideal for budget-conscious users.
$699, asus.com

Lenovo Flex 3i Chromebook

This isn't the most powerful Chromebook, but students need reliability more than power – especially if they're only really using it for homework, note-taking, and perhaps the occasional bit of Netflix.
$367, lenovo.com/au

Lenovo IdeaPad Duet

The Chromebook answer to Microsoft's Surface tablets, this is a seriously versatile device – albeit not the speediest (although we never found it to be painfully slow while carrying out everyday tasks). For this price, and with a 16hrs 14mins battery life, the Duet is a great choice.
$297, lenovo.com/au

Tablets

Apple iPad Air (M2)

We love the new iPad Pro, but for most people the M2 iPad Air is not only far better value but also all the tablet they'll need. It supports the Magic Keyboard and Pencil Pro, plus it's now available in both 11in and 13in sizes.
From $1,299, apple.com/au

Apple iPad Pro (M4)

The best tablet in the world becomes even better thanks to Apple's stunning M4 chip, a gorgeous OLED screen and the must-have accessory: the all-new Pencil Pro. But it comes with an obvious downside of cost, with the cheapest 13in incarnation costing $2,199.
From $2,199, apple.com.au

Samsung Galaxy Tab S9 Ultra

This 14.5in tablet offers a size and versatility that even the iPad Pro can't match, with its high price more than justified by the quality of Samsung's AMOLED panel, speakers and productivity software.
$1,999, samsung.com

Everyday monitors

Asus ROG Swift OLED PG32UCDP

We've seen several ultimate gaming monitors in recent months but, from the specs alone, Asus might just have made the most *ultimatest*: 480Hz refresh rate, matte-screen HDR OLED, 32-inch 4K.
$2,399, asus.com.au

BenQ BL2790QT

A 27in, 1440p monitor that's packed with quality, from its brilliant OSD to several clever features designed to fight eye fatigue. Text and images look sharp and punchy, its USB-C docking capability is always welcome, and the speakers are surprisingly decent.
$459, benq.com

LG UltraGear 32

The new LG UltraGear 32GS95UE-B. AAU is not perfect. But it does a pretty comprehensive job of blowing every existing 32-inch 4K gaming monitor based on Samsung's QD-OLED panel tech into last year.
$2,399, msi.com

Professional monitors

Eizo FlexScan EV3240X

With images that whack you between the eyes as soon as you lift it, fully assembled, from its box, this 32in 4K monitor is our top choice pick for anyone willing to make such a hefty long-term investment.
$2,696, eizoglobal.com

Eizo ColorEdge CG2700X

A brilliant choice for professional designers, whether working solo or in teams, thanks to its dedication to providing accurate colours across potentially years of life. It's also bang up to date for connectivity, with USB-C and RJ45 making it easy to manage.
$5,500, eizoglobal.com

Asus ProArt Display PA278CFRV

While it costs too much for casual users, workers and gamers, for professional designers, it's an attractive proposition with easy-to-access, designer-friendly tools and presets.
$629, **asus.com**

Home office printers

NEW

HP OfficeJet Pro 9130e

This versatile inkjet all-in-one – which includes a 35-page ADF – pumps out high-quality prints at laser-rivalling speeds. Likewise scans and copies. Print costs are reasonable, too.
$248, hp.com

NEW

Canon i-Sensys LBP243dw

Everything you could want from a mono laser printer – it doesn't come with a scanner – the LBP243dw produces excellent results at speed. You also get Wi-Fi and wired networking.
$479, canon.com

Brother MFC-J4540DW

Home workers will love this inkjet all-in-one. It combines an incredible range of features with all the connectivity you need and extreme ease of use. Output quality is fine, it offers the best cloud support around and the high-capacity ink pack could keep you going for years.
$329, brother.com

Find the best deals
on new gear at
getprice.com/au

Wireless routers

Synology WRX560

Its quad-band Wi-Fi smashed-through our performance tests managing 791.5Mbps up close, 375Mbps two rooms away and an amazing 216.7Mbps down the garden.
$419, synology.com/au

Asus ROG Rapture GT-AX16000

The most splendid, overpowered router on the market. But, it's silly money and aspirational to most users. Ultimately, though, it's currently the highest-spec consumer router available.
$999, asus.com/au

Netgear Nighthawk RS700S

Make no mistake – you won't get stunning speeds out of this Wi-Fi 7 router today. But if you must buy a router now and want future-proofing, this is a solid choice. But honestly, we would recommend that you wait.
$1,499, netgear.com

Mesh Wi-fi

TP-Link Deco XE200

There are cheaper Wi-Fi 6E meshes, but the XE200 wins for its superb download speeds, excellent coverage and the fact that older clients reap benefits of 6E, not just new ones. And a two-pack should be enough for most premises.
$1,299 (2-pack), tp-ink.com

TP-Link Deco X20

The Deco X20 makes it possible to upgrade your home network to Wi-Fi 6 for the price of some standalone routers. The HomeCare functions are also a great bonus for households where lots of devices are fighting over the bandwidth. **$227 (2-pack), tp-link.com**

Asus ZenWiFi AX

The interface and design certainly aren't the prettiest (the charcoal version is straight out of the 1980s), but if you're after strong performance, great features and plenty of expansion potential, the ZenWiFi AX is a compelling prospect.
$939 (2-pack), asus.com/au

NAS servers

Asustor Nimbustor 4 Gen2 AS5404T

A particularly strong choice as a media server, the updated Nimbustor 4 is both flexible and quick. Asustor's Nimbustor 4 AS5404T is a four-drive NAS enclosure aimed at demanding home users or small offices.
$889, asustor.com

QNAP TS-264

The TS-264 combines strong specifications and performance for a reasonable price. We wouldn't choose this NAS as a starting point for a small business, but it is a good choice as a home NAS if you'll be using it for both work and entertainment.
$649, qnap.com

QNAP TS-253E

The TS-253E is a sensible business NAS that's ideal for rolling out to multiple small offices. If you're buying for business, and particularly if you've got an eye on minimising support headaches across a group of premises, this is an excellent choice.
$858, qnap.com

Security software

Avast Ultimate

Buy from retail and this is a bargain, with a solid VPN, anti-tracking software and handy detection fees on top of excellent protection.
~$65, 1 device, avast.com/en-au

THE ALTERNATIVES

G DATA TOTAL PROTECTION
Despite its quirks, G Data provides straightforward, effective and inexpensive protection against malware and other threats to your system. **1 device, US$50, avast.com**

AVAST ONE ESSENTIAL
Essential has the same malware-detection engine as our top choice, but for free. It even includes 5GB of VPN services per month and a few system optimisation tools.
Free, avast.com

NordVPN

NordVPN provides consistent and fast speeds, serious security, great support for video-streaming services and some cost-effective subscription rates.
$59 per year, nordvpn.com

THE ALTERNATIVES

PROTONVPN
ProtonVPN provided one of the best free offerings of all the VPNs in our group test, including unlimited data, but upgrade to benefit from even faster speeds and many more options.
Free, protonvpn.com

SURFSHARK
A strong rival to NordVPN, especially if you're willing to commit to its two-year contract. It's fast, cheap and a fine choice for people who like to switch to US streaming services.
$79.61 for one year, surfshark.com

Bitwarden

Bitwarden has a huge advantage: it's free. It isn't as slick as some paid-for rivals, but it can sync passwords across all devices for no extra charge. **Free, bitwarden.com**

THE ALTERNATIVES

DASHLANE
A manager that's ideal for beginners, and it even builds in an unlimited (if basic) VPN service. Note you may prefer to buy the Family plan ($60 per year) as this extends the service to six people.
$55.99 per year (Premium), dashlane.com

1PASSWORD
1Password is targeted at users who are looking for the last word in security. It even offers a Travel Mode that may ease your mind if surrendering your phone to customs officials. **$54.99 per year (individual), 1password.com**

THE LIST

The best OLED gaming monitors

5
THE WITCHER WILD HUNT
ALIENWARE

4
MPG
MSI PERFORMANCE GAMING
msi

2
QD OLED
240Hz
0.03ms
OLED CARE 2.0
MPG
MSI PERFORMANCE GAMING
32
4K UHD
3840 x 2160
90W
msi

1
LG UltraGear™ OLED

Ridiculously fast response times, per-pixel lighting, stupendous HDR performance, almost infinite viewing angles – OLED displays have everything. They're now available in a multitude of form factors, and they're getting cheaper. Okay, they're not truly cheap yet, but they are becoming more affordable. Here's our pick of the best that are currently available.

5 ALIENWARE 34 QD-OLED AW3423DWF

Alienware was pretty much first to market with an OLED gaming monitor, and the AW3423DWF was a slight revision on that early entrant. It was a bit cheaper thanks to 165Hz rather than 175Hz refresh and the removal of the Nvidia G-Sync chip. Even now, its QD-OLED panel is a ripper, and it's been gradually getting cheaper. Today, it's just $1,400 – a full $300 cheaper than its launch price, meaning it's much easier to recommend.
$1,399, www.dell.com

4 MSI MPG 271QRX

We're not totally convinced by the basic proposition of 27-inch 1440p OLED panels, just because they're awfully expensive for their size and resolution. But if it's 27 inches and 1440p you want, the MSI MPG 271QRX makes a lot of sense. It's more affordable than many of the alternatives, but still gives you a 360Hz refresh rate from a stellar Samsung QD-OLED panel. Combined with 0.03ms response times, this is a seriously speedy display. MSI also includes USB-C with 90W power delivery, just to sweeten the deal.
$1,279, www.msi.com

3 SAMSUNG ODYSSEY OLED G9

Samsung's 49-inch curved monster delivers a stupendous gaming experience thanks to its QD-OLED panel tech. Gaming on a large display with such incredible HDR performance and response is an experience you will not quickly forget. That said, the 32:9 aspect ratio isn't a great fit for all gaming genres, and the pixel density is short of the 4K alternative. But if you want the absolute maximum in immersion, this is as good as it gets.
$2,299, www.samsung.com

2 MSI MPG 321URX QD-OLED

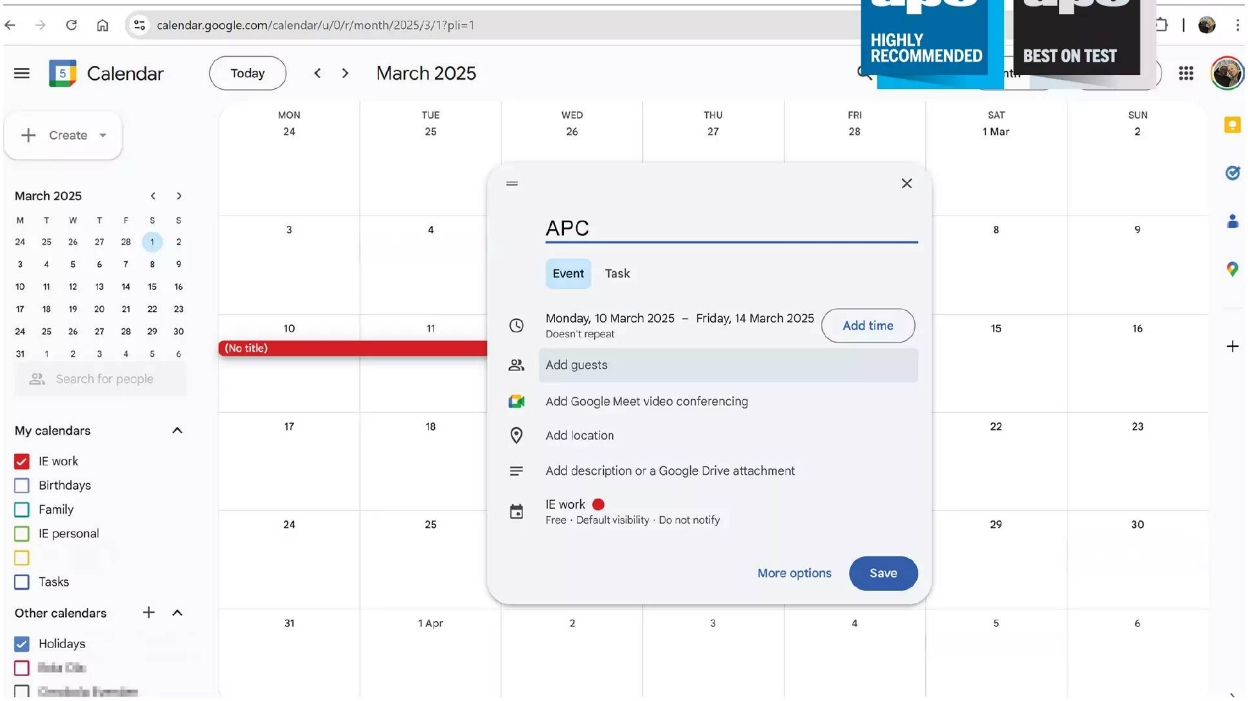
We were keen to get our filthy paws on the MSI MPG 321URX. Why? Simple: it's one of the cheapest 4K 32-inch OLEDs available. It has all the upsides of Samsung's QD-OLED tech, including decent full-screen brightness, perfect per-pixel lighting, fabulous HDR performance, and low response times, but comes with few downsides. MSI offers an even cheaper version with a lower refresh rate, but we like this one thanks to its USB-C port with 90W of power delivery.
$1,799, www.msi.com

1 LG ULTRAGEAR 32GS95UV

The new-gen WOLED panel has the edge on Samsung's 4K QD-OLED tech. It's marginal, but the colour balance is more accurate, and it's probably a hair brighter. The catch? A matte rather than glossy coating, but it works. What's more, you get a nifty 480Hz 1080p mode. It's not quite like native 1080p, but it's close, and you get the low latency benefit of that ultra-high refresh rate.
$1,879, www.lg.com ■

apc HIGHLY RECOMMENDED

apc BEST ON TEST



APC

Event | Task

Monday, 10 March 2025 – Friday, 14 March 2025
Doesn't repeat
Add time

Add guests

Add Google Meet video conferencing

Add location

Add description or a Google Drive attachment

IE work
Free · Default visibility · Do not notify

More options | Save

Google prefers to let its calendar fill the screen, with app shortcuts behind buttons.

GOOGLE CALENDAR Free for Google Account holders, calendar.google.com
MICROSOFT OUTLOOK Free for Microsoft account holders, outlook.live.com

Google Calendar vs Outlook Calendar

Ian Evenden keeps to schedule with these timetable apps

Calendar apps are possibly some of the least exciting software on our PCs, but also ones that we depend on every day to keep our lives organised. There are lots of them, too, with offerings from software and hardware companies, as well as cellphone apps and web-only solutions.

There are two, however, that stand out. Google Calendar needs little introduction – all the information you need is in the name. Then there's Microsoft's calendar app, which goes by the name of Outlook, named for a personal information manager app that was launched in 1997. It's also a name that Microsoft is reintegrating into Windows 11, replacing the Mail and Calendar apps that ship with the OS with an Outlook app since the end of 2024.

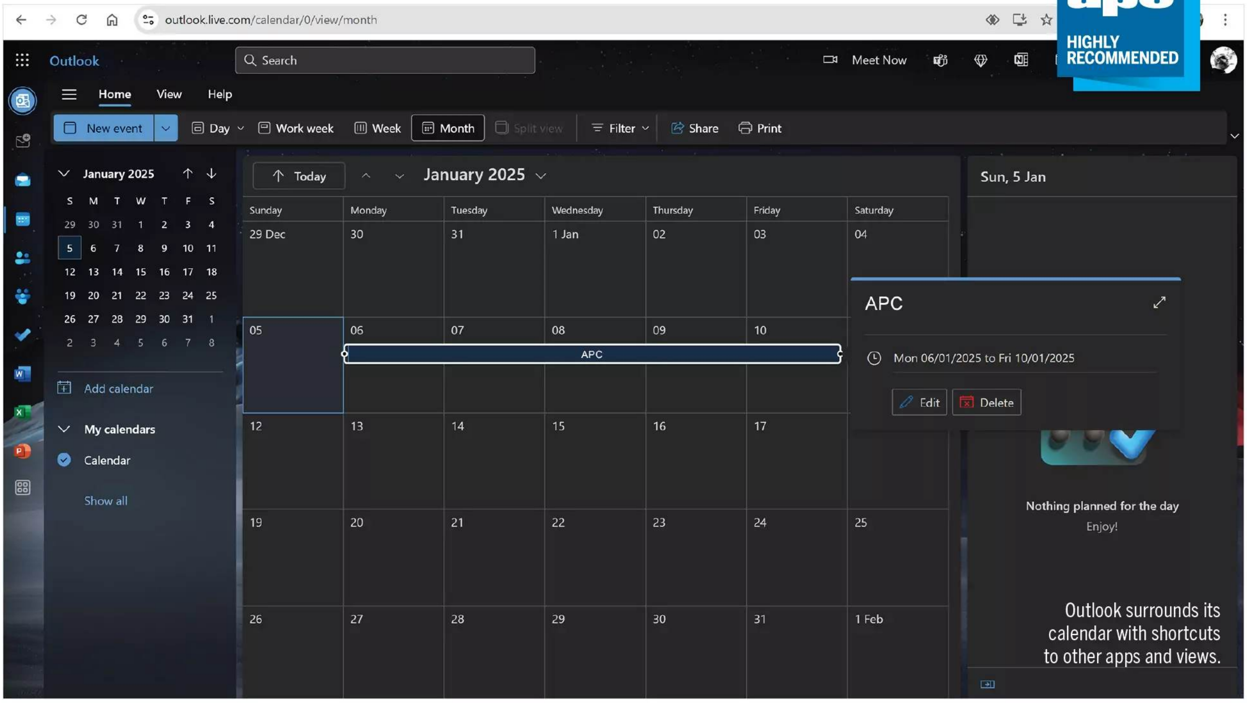
While the two calendar systems have many features in common, there are plenty of differences. Which one you choose, however, may depend on the broader app ecosystem you want to invest in as much as the app itself. Both Microsoft and Google offer office suites and software to be used alongside their calendars, as well as applications to get them onto your PC and mobile devices, and the quality and user-friendliness of these can easily affect your decision. You'd never choose an office suite just because of its calendar app, but it's an important part of the wider system, and worth thinking about.

Google Calendar

On the web, Google Calendar received a facelift in 2024 in line with Google Material Design 3. This design language, introduced in 2021 and also known as Material You, brings increased animation, larger buttons, and the ability for custom UI themes to be generated, but you're unlikely to see much of those in the Calendar app, which resizes itself to fit the window you're viewing it in. Responsive, flat design has long been part of how Material Design do things, and Material You just makes everything easier to use.

Many will be viewing Google Calendar through an app, which can force its own UI onto the calendar data. Looks are important, however, and the way data is displayed can make a big difference. Google Calendar and Outlook's web interfaces look similar, made up of squares to represent dates like a paper calendar you might hang on your wall.

A benefit of Google's calendar is the sheer number of Android phones that use it as their default calendar app. While Apple's Calendar app (formerly iCal) is often the choice of iPhone users, it is



APC

Mon 06/01/2025 to Fri 10/01/2025

Nothing planned for the day

Enjoy!

apc HIGHLY RECOMMENDED

Outlook surrounds its calendar with shortcuts to other apps and views.

much less broadly supported across devices, though can be synchronised with both Google Calendar and Outlook.

If you're already a member of the Google ecosystem, then using Google Calendar is pretty much a no-brainer. It offers a lot of collaboration features, including integration with other Google products such as Meet. Its colour coding also makes it easy to differentiate multiple calendars when they're all displayed.

However, some functionality is restricted to work or school accounts, such as the ability to draft a calendar event from within Google Docs. While this kind of gatekeeping is probably meant to drive users toward a Google Workspace subscription, the missing features for the Calendar app are minor, and more likely to affect users of Google Drive or Docs.

Microsoft Outlook

Unless you're a Linux fiend using a load of FOSS apps, it's likely as a PC user that you use Microsoft products. This means that if you've been keeping up with Windows updates, you've recently seen the Mail app become Outlook. This is a different app to the old Outlook Express in Windows 98, but it remains a combination of mail, calendar, and contacts. In these days of web apps, there is perhaps less incentive to use it, as you can open your mail and calendar in your browser and get more or less the same experience, but the new Outlook app does look pretty good, and allows you to bring all your mail accounts together in one place.

We're not here to talk about mail apps, though; it's calendars we're concentrating on, and Microsoft's is excellent. It's been making them for years, and it all works in a similar way to Google Calendar or any other organisation app. You get a familiar grid of dates, and can add your appointments and reminders to them at the appropriate dates and times. You can set reminders, and use official or third-party mobile apps to sync your calendar, and have the information you've added displayed on other devices. It uses colour coding, and can display multiple calendars that you can share with others.

So far, there's nothing that Google can't do, but Outlook's calendar is tied in with Office 365 and Teams, which if you're a heavy user of these applications, can make it a more attractive app than Google's. The way its web interface is laid out is more pleasing than Google Calendar, too, with a task view on the right-hand side, and a bar on the left that holds shortcuts to your Outlook mail, as well as Word, Excel, and PowerPoint web apps. Again, Google has the same thing, but you'll need to press a button and drop down a menu to access most of them. Outlook also keeps a 'Meet Now' button, and a shortcut to Teams, at the top of its interface, which will save time if you're in a position to be pulled into a meeting at a few moments' notice.

Historically, one of the biggest differences between Google Calendar and Microsoft Outlook has been that the former is used at home, and the latter in the office. This is changing, however, with the introduction of Google Workspace Enterprise and more companies moving their email and office operations to the cloud via Google. Microsoft's cloud offering, with OneDrive, Teams, and web versions of the core Office apps, is also comprehensive, though often geared more toward enterprise than home users.

Either of these apps will fulfill your calendar needs, with the ability to sync to various devices or share appointments or even entire calendars with others. The one you choose may depend on which email service you're currently using – few of us are untouched by Google or Microsoft's digital offerings – and if it's organisation you're after, either will get you where you need to be. ■

VERDICT

★★★★☆

Google Calendar An effective calendar app that comes with plenty of free features. Some functionality is for school or work accounts only.

★★★★☆

Microsoft Outlook A good-looking calendar app that you probably already have. Possibly too much workplace integration for home users.

GADGETS

Nice things to have

B&O Beoplay Eleven

Looking for an even more stylish alternative to Apple's AirPods? Give these wireless earbuds from Danish audio makers Bang & Olufsen a try.

Available in Natural Aluminium and Copper Tone finishes, they boast an AirPods Pro-like in-ear design with Active Noise Cancelling (ANC) to keep unwanted sounds out and great sounds in. Equipped with six microphones, the Beoplay Eleven include both Wind Guard (to reduce ambient wind noise) and Transparency modes (to let some sounds in), as well as Bluetooth multipoint so you can seamlessly switch between devices without missing a beat. Water- and dust-proof to IP57 and made from aluminium and toughened glass, the earbuds can last for up to six hours between recharges (with ANC on) with an additional 14 hours provided by the case. Their batteries are also replaceable for sustainability.

$910 | **bang-olufsen.com**

BANG & OLUFSEN

Classic design, great build quality and comfort are all combined with Bang & Olufsen's top-notch audio integrity.

Marantz Grand Horizon

Sticking with luxury audio, how about this? Available in Midnight Sky, Moon Ray and Champagne finishes, the Grand Horizon wireless stereo speaker has a built-in Rise amplifier that's capable of delivering a staggering 370W of thrilling, high-fidelity sound with a frequency response of 28Hz-20kHz and 111dB.

Equipped with Bluetooth 5.4 and AirPlay 2, it's also compatible with a wide range of music streaming services including Tidal and Spotify Connect, support Dolby Atmos and offers a host of wired analogue and digital audio connections, including USB-C.

$9,500 | **marantz.com**

When your home speakers look and sound as beautiful as this, you really do want to face the music.

Twelve South HiRise 2 Deluxe

Offering Qi2 wireless charging for your iPhone, AirPods (or any other compatible devices), this stand features a 15W StandBy Mode optimised charging pad with a 70-degree tilt range for an optimal viewing angle while charging and watching movies during online work meetings. There's also a 5W charge pad integrated into the base for simultaneous charging, which is perfect for your AirPods or another device. Available in white or black, the vegan leather clad HiRise 2 looks the goods in any home or office.

$139, www.twelvesouth.com.au

Satechi Qi2 Trio

Now upgraded with Qi2 technology, the Trio is a 3-in-1 wireless charger with support for phones, ear buds and smart watches. Designed to fold flat for travel, the Trio can supply up to 15W of power to iPhone, 5W to your AirPods and another 5W to Apple Watch and includes a USB-C 45W PD charger plus adaptors. Made from aluminium and vegan leather, its charging pads for phones and watches work great with StandBy and Nightstand modes, so it'll look as good on your bedside table as it does on your desk.

$169 | **satechi.net**

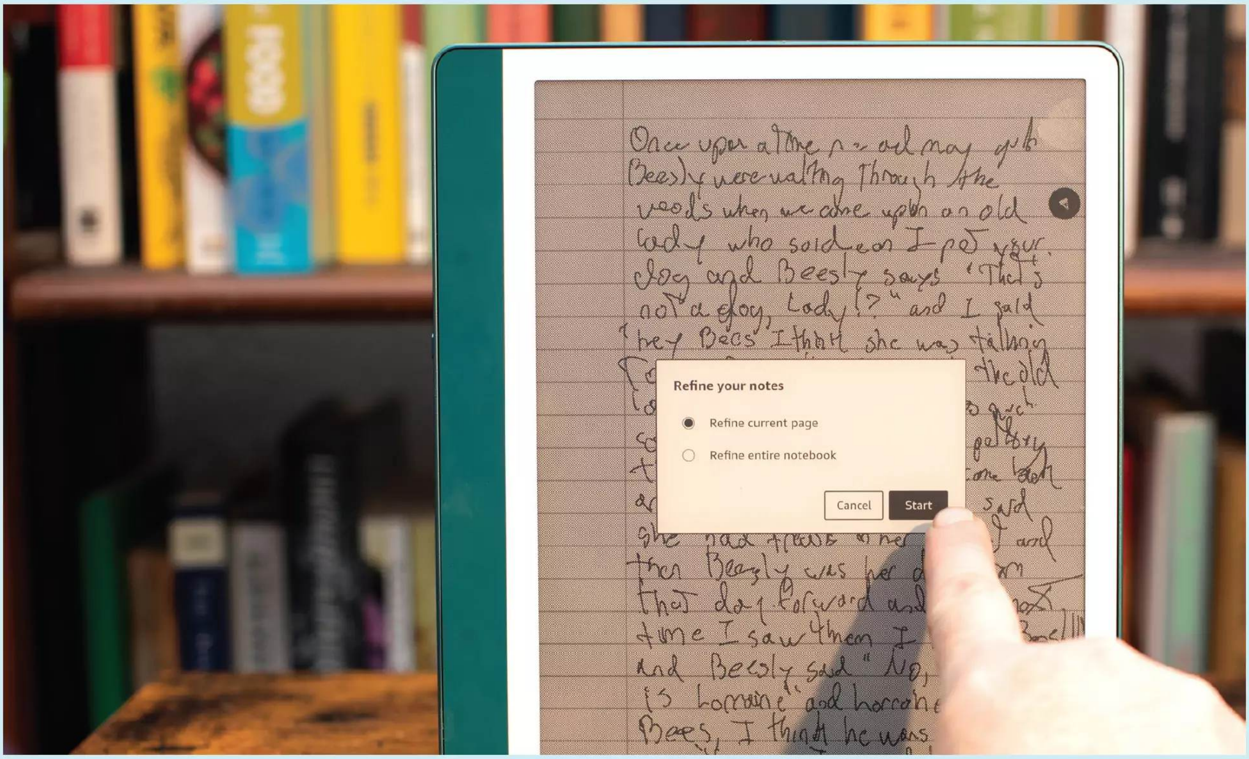
GameSir Cyclone 2

With mobile gaming now exploding in popularity, now might be a good time to up your game. To help, the Cyclone 2 gamepad will not only work with your smart hone and tablet, but is also equipped with Mag-Res TMR and Hall Effect triggers, and a Hair Trigger Mode. Available in Shadow Black and Phantom White, the Cyclone 2 also includes an RGB lighting strip, rumble motors and a Turbo function and can be used wired or wirelessly via Bluetooth. You can also plump for a Charging Station Edition (shown) for $159.

$75| **gamesir.com**

REVIEWS

Expert reviews and recommendations to help you buy with confidence



33 Oppo Find X8 Pro 34 Asus CX34 Chromebook Plus 35 MSI Titan 18 HX 36 MSI MPG 321CURX QD-OLED
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APC is Australia's oldest consumer technology magazine – having been consistently in print for over forty years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech, too, from smartphones and apps to peripherals, accessories, and beyond. We have two goals: to find the best modern tech and to help you make the most of it.

Independent reviews

Championing technology doesn't mean we're unrelenting yes-men and -women, however, and *APC* aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three attributes.

As a matter of policy, reviews published in *APC* are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an *APC* reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

Labs testing

APC strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance including storage read and write speeds, gaming and battery life.

APC EDITOR'S CHOICE
When a product scores 4.5 out of 5, it carries the Editor's Choice Award. These are products that exceed expectations and deliver a quality experience up there with the very best.

APC HIGHLY RECOMMENDED
You will see this award if a reviewed product has scored four out of five stars. It means most people can expect satisfying performance from the product, and that we would use it ourselves.

PRICE $1,799 **WEB** oppostore.com.au

Oppo Find X8 Pro

An "ultra" phone in all but name, this is an excellent alternative to Apple's and Samsung's flagships.

apc
HIGHLY RECOMMENDED

Owned by the same firm as OnePlus, Oppo isn't a huge name in Australia, but the Find X8 Pro demands attention with a big, bright display, four rear cameras, a huge battery and a surprisingly reasonable price.

That's not to say it's cheap. At $1,799 we're in premium territory, but that includes 16GB of RAM and 512GB of storage, which is more than you'll find on rival phones in this price range.

The big camera block at the back reflects the OnePlus connection, and Oppo has also borrowed the physical alert slider from OnePlus, which is handy for quickly switching between regular, silent and vibrate-only modes.

The display is curved on all edges, making it comfortable to hold both vertically and horizontally. The 6.8in AMOLED panel is perfectly sharp at 449ppi, and Oppo claims an impressive peak brightness of up to 4,500cd/m2, along with an adaptive 1-120Hz refresh rate. Toughened glass and aluminium rails ensure everything's sturdy, and an IP69 rating indicates an unusual degree of waterproofing.

Another notable design feature is the touch-sensitive Quick button on the side. This works similarly to the iPhone 16's Camera Control, allowing you to open the camera, swipe to zoom and tap to fire the shutter. It's not as versatile as Apple's version, but it's arguably easier to use.

The cameras comprise a regular main shooter, an ultrawide module and two telephoto units offering 3x and 6x magnification. All have a 50MP resolution, so you can expect consistent levels of detail.

Image quality tends toward the dramatic, with dark shadows and bright highlights. The results aren't as natural as images from, say, the Google Pixel 9 Pro XL, but it's a bold style that doesn't look bad at all. There's plenty of detail too, although the Oppo's preference for strong contrast can crush details in scenes with lots of light and shade.

Inside, the Oppo Find X8 Pro is driven by a MediaTek Dimensity 9400 chip. It's an unusual choice, but you can't argue with results: in Geekbench the Find X8 Pro beat the Snapdragon 8 Gen 3-powered OnePlus 12 in both single-core and multicore tests, and even beat the iPhone 16 Pro Max in the multicore test. It also outperformed its rivals in the Wild Life Extreme Unlimited GPU test, so whether it's productivity apps or graphics-heavy games you want, you're well covered.

Another unusual feature is the silicon-carbon battery. This has a high 5,910mAh capacity, and the Oppo ran down more slowly than other phones: playing three hours of YouTube videos ran down the charge by 14%, while the Galaxy S24 Ultra dropped by a huge 21% in the same time.

The Find X8 Pro runs Oppo's Android-based ColorOS, and comes with a promised five years of updates, plus an extra year of security updates. Inevitably, the latest version includes all the usual AI features, including summarisation, translation, audio transcription, text generation and photo-editing tools. However, Oppo does better than most in making them conveniently available, via an AI toolbar that swipes in from the side of the screen with context-based tool suggestions.

You won't find a quad-camera array anywhere else for this price, and it comes with strong battery life, a handsome screen, competitive performance and bags of storage. ■

SPECS 8-core MediaTek Dimensity 9400 SoC; 16GB RAM; Immortalis-G925 graphics; 6.8in 120Hz AMOLED screen, 1,264 x 2,780 resolution; 5G; 512GB storage; dual nano-SIM IP68 quad 50MP/50MP/50MP/ 50MP rear cameras 32MP front camera; Wi-Fi 7; Bluetooth 5.4; NFC; 5,910mAh battery; USB-C 3.2 Gen 2 connector; Android 15 (5 major updates) with ColorOS 15; 77 x 8.2 x 162mm (WDH); 210g; 2yr warranty.

VERDICT

★★★★☆

The Oppo Find X8 Pro is a compelling alternative to the latest Google and Samsung phones.

Richard Priday

PRICE $699 **WEB** asus.com

Asus Chromebook Plus CX34

A sleek and relatively affordable ChromeOS workhorse.

The Asus Chromebook Plus CX34 shows how much value ChromeOS devices can pack into a budget-friendly package, if priced well. Built around Google's Chromebook Plus initiative, this laptop aims to challenge entry-level Windows devices by delivering reliable performance, robust features, and unique design elements. In other words, an everyday laptop or even work from home machine that's affordable, but also actually nice to use.

Under the hood, the older but decent Intel Core i3-1215U (as tested) or i5-1235U CPU is good enough to ensure smooth multitasking, while the 8GB of LPDDR5 memory is sufficient for light to moderate workloads like streaming, document editing, and running Android apps. The CX34 is sold with a 128GB, 256GB or 512GB SSD – though only the latter is a full speed NVMe M.2 drive. The 14in display (1920 x 1080) offers up sharp visuals, can fold back through 180 degrees, and features an anti-glare coating that helps make it more usable in bright environments. That said, its 250-nit brightness and 45% NTSC colour gamut place it slightly behind higher-tier options for those focused on media playback or photo editing. The display is perfectly fine for general productivity and streaming, and the anti-glare surface is effective. For WFH or staying in touch, it has a 1080p webcam that delivers sharp, clear video, plus further enhancements thanks to ChromeOS's AI tools like background blur and noise cancellation.

The keyboard delivers a satisfying typing experience, with 1.4mm key travel providing responsive feedback, while the trackpad, though functional, could do with better click feedback. Connectivity is better than expected, with two USB-C 3.2 Gen 1 (5Gbps) ports that support power delivery and display output, alongside two USB-A ports, HDMI 1.4, and a 3.5mm combo audio jack. Wireless connectivity includes Wi-Fi 6 and Bluetooth 5.3, which gives a stable and fast connection.

Benchmark results back up the CX34's performance claims, with Geekbench 5 scores of 1,458 (single-core) and 4,507 (multi-core), a JetStream 2 score of 242, and an Octane 2.0 result of 83,372. The WebGL Aquarium test delivered 45fps with 30,000 fish, demonstrating the laptop's capabilities for web-based graphics. These results are generally better than, or at least comparable to similar spec Windows laptops. In battery testing, the CX34 achieved an impressive 10 hours and 21 minutes. In real-world use, the CX34 excelled in casual browsing and light productivity tasks, though power users may have encountered limitations with excessive multitasking or browser tabs. At 1.44kg and measuring 32.64 x 21.43 x 1.87 cm, the CX34 strikes a good balance between portability and usability.

The CX34 offers fairly seamless integration with Google Play and has access to thousands of Android apps from productivity tools like Adobe Photoshop and LumaFusion to games, and opens up a diverse range of possibilities. For example, Minecraft, now optimised for Chromebook, provides an engaging gaming experience with full cross-play support.

Overall, the Asus Chromebook Plus CX34 delivers a solid combination of performance, design, and functionality. While its display and trackpad leave room for improvement, the overall value proposition makes it a worthy buy. ■

BENCHMARK RESULTS	Asus Chromebook Plus CX34	Acer Chromebook Plus 515
CPU	Intel Core i3-1215U	Intel Core i3-1215U
RAM	8GB	8GB
Battery Capacity	50Wh	53Wh
RRP	$749	$799
Geekbench 5 - Multi-core (score)	4,507	4,510
Geekbench 5 - Single-core (score)	1,458	1,436
Mozilla Kraken (lower is better)	476ms	488ms
JetStream 2 (higher is better)	242	259
Octane 2.0	83,372	83,806
WebGL Acquarium 30,000 fish	45 fps	50 fps
Battery life - 1080p video playback (h:min)	10:21	5:13

SPECS ChromeOS; 14in, FHD (1920 x 1080), 250 nits, anti-glare; Intel Core i3-1215U; 8GB LPDDR5; 256GB UFS; Wi-Fi 6; HDMI 1.4; USB-C with power delivery; 50Wh battery; 32.64 x 21.43 x 1.87 cm; 1.44kg.

VERDICT

★★★★☆

The Asus Chromebook Plus CX34 delivers strong performance and features at a competitive price when on sale, and is ideal for budget-conscious users.

Lindsay Handmer

PRICE $8,999 **WEB** au.msi.com

MSI Titan 18 HX A14V

A wallet-busting powerhouse that pushes the limits of gaming laptops.

The MSI Titan 18 HX is a laptop for those who demand no compromises in power, performance, and luxury. Designed as a true desktop replacement, this 18in behemoth offers cutting-edge specs and features tailored to extreme gamers and perhaps even creative professionals. However, with prices in Australia starting from around $7,000 depending on spec, it's far from accessible for most users.

MSI's flagship packs an Intel Core i9-14900HX processor, an Nvidia RTX 4090 (or 4080) GPU, 16GB to 128GB of DDR5 RAM across 4 slots, plus as much as 4TB of SSD storage in dual M.2 slots – pushing the boundaries between gaming laptops and desktops. Its 4K Mini LED display (3840 x 2400) delivers excellent visuals, with a 120Hz refresh rate, HDR1000 certification, and top-notch colour reproduction (112% DCI-P3). This makes it equally suited for gaming or creative pursuits such as video editing. Connectivity is another highlight, with three USB-A ports, two Thunderbolt 4 ports, HDMI 2.1, Ethernet, and a full-size SD card slot, all complemented by Wi-Fi 7 and Bluetooth 5.4.

The mechanical keyboard features Cherry MX low-profile switches that offer a satisfying tactile experience, while the haptic RGB-lit touchpad is responsive and blends seamlessly into the design, the physical borders can be a little frustrating. Build quality is robust, with a magnesium-alloy chassis and subtle blue accents adding a touch of elegance. At 3.6kg and measuring 40.4 x 30.7 x 3.2cm, the Titan 18 HX is not the most portable, but to be fair, it's a moveable desktop replacement rather than a laptop to carry every day.

Performance is where the Titan truly shines, and it achieves 174 fps in *Horizon Zero Dawn* at 1080p (87 fps at 4K), 72 fps in *Cyberpunk 2077* at 1080p with Ultra ray tracing (though just 20 fps at 4K), and 117 fps in *Metro Exodus* at 1080p Ultra (54 fps at 4K). It also excelled in *Red Dead Redemption 2* with 135 fps at 1080p and 71 fps at 4K. These results compare well to (or exceed) that from most other similar specced gaming laptops. Its cooling system had no issue keeping thermal throttling at bay, but the fans can get loud under heavy loads, making a gaming headset almost essential. Beyond gaming, the Titan excels at high-resolution video editing and 3D rendering, thanks to its top-tier specs and reliable thermal performance.

Despite having a 99.9Wh battery, time unplugged is predictably short, and it lasts just under three hours for light tasks and barely an hour for gaming. This is expected for a machine of this size and power, but at least the compact 400W power brick makes it a bit easier to keep it plugged in.

All-in-all the MSI Titan 18 HX is an engineering marvel, offering unmatched performance for those who can afford its luxury price tag. ■

BENCHMARK RESULTS	MSI Titan 18 HX	Lenovo Legion 9 (Gen 8)
CPU	Intel Core i9 14900HX	Intel Core i9 13980HX
GPU	RTX 4090 175W	RTX 4090 175W
RAM	128GB	32GB DDR5
Street Price	$8,999	$8,199
3DMark TimeSpy Extreme CPU	9,794	8,968
CPU encoding | X264 v5.0	85.89	81.23
Blender 3.3.0	123.67	122.39
Cinebench R23 - CPU Single Core	2,184	2074
Cinebench R23 - CPU Multi Core	29,438	28,331
3DMark Port Royal	14,068	14,068
3DMark Time Spy Extreme	10,934	10,840
Cyberpunk 2077 - 1080p Ultra	72	66
Cyberpunk 2077 - 4K Ultra	20	26
F1 2022 - 1080p Ultra	122	100
Horizon Zero Dawn - 1080p Ultra	174	163
Metro Exodus - 1080p Ultra	117	118
3DMark Storage	2,950	2,859
Gaming (HH:MM)	01:23	00:40

SPECS W11 Home/Pro; 18in, 3840 x 2400, Mini LED, 120Hz; Intel Core i9 HX; RTX 4090; DDR5 up to 192GB; up to 4TB SSD; 99.9Wh battery; Wi-Fi 7; RJ45; dual Thunderbolt 4, HDMI 2.1, SD Express; 404 x 307 x 32mm; 3.6kg.

VERDICT

★★★★½

The MSI Titan 18 HX offers unmatched power and luxury, but its high price and poor portability does limit the appeal to those seeking a no-compromise desktop replacement.

Lindsay Handmer

APC EDITOR'S CHOICE

PRICE $1,799 **WEB** msi.com

MSI MPG 321CURX QD-OLED

MSI knocks it out the park.

We recently reviewed the best monitor we've ever seen: Asus' ROG Swift OLED PG32UCDP, which has a reflection-free OLED screen and a 240Hz refresh rate that can boost to 480Hz in a special Full HD mode. The problem? It costs, $2,399. We also reviewed MSI's 321URX rival which was similar but less-good all round. Now here's the MPG 321CURX QD-OLED which adds a slight curve and an upgraded 3rd-gen QD-OLED panel with more brightness and HDR. Can it finally topple Asus' monster?

Set-up is simple, thanks to a clip-on stem and a thumbscrew-attached, pronged base. This keeps everything stable and offers generous adjustments in terms of tilt, swivel and height.

Turning it on greets you with a matte, 4K OLED screen with sumptuous colours and practically no reflections. Unlike early generations of QD-OLED, the 3rd-gen panel has no issues rendering crisp and clear, spider-free text and so we were more than happy to use it for day-to-day work. The slight curve – rated at 1700R – isn't much but it does add extra comfort from not having to refocus your eyeballs when panning around all 32-inches of the display.

Multimedia looks great with default settings thanks to vibrant, saturated colours and excellent contrast. However, in SDR mode, while there's minor stepping apparent in colourful gradients, monochromatic equivalents get blocky and messy. But, unlike its predecessor, it offers proper HDR modes and two of them, to boot. These can easily be selected using the responsive OSD menu (and joystick button) which provides a choice between 'True Black 400' or 'Peak 1000 nits.'

We quickly fell in love with the former setting. Not only did it smooth out all colourful and monochromatic gradients it simultaneously revealed bright and dark details across all media. This enhanced all videos that we watched and meant we missed very little when playing games (including enemies hiding in shadows or jumping out from the sun). It was also balanced enough to mean we had few issues keeping it on when doing office work, too. Switching-up to the 1000-nit peak brightness setting slightly knocked gradient smoothness and meant that details could get lost in bright areas, but it made up for this with an engrossing, eye-melting multimedia experience with bright lights shining-out of true-black backgrounds being the highlight. You wouldn't want it on all the time, but for some media, it looked stunning.

As for gaming, the 240Hz refresh rate married with the quick, OLED pixel response time to produce near-blur free movement in fast-and-frantic games. Other gaming features include onscreen crosshairs, the usual game-genre-related picture presets plus the ability to change the aspect ratio and reduce the display to 24.5 or 27-inches for competitive FPS players. You can also program quick-function buttons and manually activate the otherwise-automated OLED Care anti-burn-in technologies (the screen is also backed with a 3-year burn-in warranty). While other monitors offer more incremental adjustments, this feels more simple and intuitive.

At $1,799 it's expensive but significantly cheaper than many premium rivals and that's why it's our new Editor's Choice. ■

SPECS 32-inch, matte, 3,840 x 2,160, HDR10, 240Hz, QD-OLED. 0.03ms GTG response time. 250-nit brightness (1000-nit peak). 1,500,000:1 contrast. 1x DisplayPort 1.4a, 2x HDMI 2.1, 1x USB-C (with 98-Watt PD), 2x USB-A 2.0, 1x USB-B 2.0 upstream, headphone jack. Tilt +15° -5°, Swivel +30° -30°, Height +100mm. 714 x 318 x 472mm, 11.9KG.

VERDICT

★★★★★

The best monitor you can buy.

Nick Ross

apc
HIGHLY RECOMMENDED

PRICE $699 **WEB** www.dell.com

Alienware 27 AW2725QF

Alienware's 27-inch IPS monitor is a capable and flashy winner.

The Alienware 27 AW2725QF tricked me. When I pulled it out of the box and set it up, I originally assumed that it was an OLED monitor, down to its impressive matte screen and handling of darkness, forgetting that it was instead an IPS screen. OLED is the direction many monitor makers are heading in, but the AW2725QF reserves a space for graphics and competitive game lovers who don't want to spend too much. You fooled me, Dell!

The AW2725QF fills the niche of wanting a high-end monitor that sheds the high cost of OLED, ditches the curved display and doesn't bother with ultrawide proportions. For gamers looking to make their gameplay as beautiful as possible, the 3840 x 2160 resolution supports up to a 180Hz refresh rate. For competitive players, the 1920 x 1080 FHD mode sports an impressive 360Hz refresh rate.

Setting it up as soon as it was delivered, I was immediately underwhelmed by both the SDR and HDR brightness, though for the picture quality produced, I can forgive this shortcoming. Needless to say every game I put the monitor through, including *Marvel Rivals*, *Diablo IV*, *Hollow Night*, *Need for Speed: Unbound*, *Ghost Recon: Breakpoint* and *Forza Horizon 5* looked gorgeous, and it was a sufficiently capable monitor for streaming and getting work done. The anti-reflection display is brilliant and keeps you immersed.

Down to the monitor's shape, it has a small footprint on a single stand, with VESA mount capability and 26W power consumption delivered by a common C13 plug, plus a neat headphone hanger that tucks in and out of the left side. It's easy to throw together and I did it without tools in five minutes. Its bezels are noticeable but not too big, with 'Alienware' written at the bottom of the screen. It can swivel generously in all directions, and ascend and descend tall or short on its stand. There's also two RGB-programmable LED lights on the back of the unit, one in the shape of the number 27 and the other shaped like Alienware's iconic martian logo.

As for on-monitor software, this is controlled through a handy joystick at the bottom of the display, and there are some basic RGB controls here too. The RGB-programmable lights can be changed through Alienware Command Centre, installed on your computer and communicated to the monitor via an additional data cable included in the box.

Speaking of ports, the AW2725QF is certainly not lacking, with its single DisplayPort, two HDMI 2.1 ports, and handy range of USB-C connections. I'm quite fond of the placement of a USB-A and USB-C port at the underside of the front, perfectly positioned for charging a phone.

The only port I'd add is a 3.2mm headphone jack, and down to how I use computers personally, I do wish it came with in-built speakers, for the times I don't wish to wear headphones.

Ultimately, it's the most attractive IPS monitor I've ever seen from Alienware, and if they released this exact model in a 32-inch size, it'd be easy to sell me on – before I make the jump to OLED, of course. ■

SPECS 27-inch, matte, 3,440 x 1,440, HDR, 360Hz, IPS. 0.5ms GTG response time. 400-nit brightness (600-nit HDR). 1,000:1 contrast. 2x HDMI 2.1, 1x DisplayPort 1.4 out, 3x USB-A 3.2 Gen 1 downstream, 1x USB-B 3.2 Gen 1 upstream, 1x USB-C 3.2 Gen1 downstream. Tilt, Swivel and Height adjustment: Yes (unstated). 611.44 x 518.68 x 67.40mm, 4.75KG.

VERDICT

★★★★☆

A brilliant monitor for competitive gamers and graphics lovers alike.

Zachariah Kelly

PRICE $619 (CP1350); $699 (CP1600) **WEB** cyberpowersystems.com

CyberPower CP1350EPFCLCD UPS

A simple yet well featured UPS for basic home or small office protection.

Expansion Port
Provides SNMP Card Communication
USB
SERIAL
NETWORK
IN
OUT
RESET
AC INPUT
DISPLAY
MUTE
ENTER
SETUP
230
USB-A
USB-C
CyberPower
1350 VA
apc
HIGHLY RECOMMENDED

Some of us never experience power blackouts – the lucky ones that live in apartments with back up generators, mostly, but for most people – especially those in areas that are vulnerable to blackouts like many rural areas – a UPS is essential. Whether you have it active at all times to protect critical work, or just keep it stored and ready to go for unexpected emergencies, a decent UPS brings peace of mind and protection.

Expectations need to be reasonable for how you use a UPS at home. A connected PC drawing 600w for example will be UPS-powered for just five minutes, which may sound paltry, but it's enough to save your work, or win your gaming tournament if you're lucky. The company described this model as ideal for gamers, but in reality that's a bit of a stretch. If you work on a laptop, the UPS can power your router (typical draw around 5w) for several hours while you work on laptop battery power, and that's the sort of scenario most of us will find useful.

The CyberPower CP1350EPFCLCD is one of two new models from the well-established company, being 1,000 watt (CP1600) and 810 watt units. We have the 810 watt CP1350 for review today.

It's a pure sine wave UPS, with automatic voltage regulation. A pure sine wave UPS is preferable to cheaper simulated sine wave UPSs due to the power delivery being cleaner and smoother, operation being more efficient and thus a greater backup capacity, all other things being equal. It also features CyberPower's proprietary GreenPower tech, which simply bypasses automatic voltage regulation when utility power is normal, thus reducing the power the UPS needs in operation, and reducing the heat and running costs. This feature can be turned on or off as desired.

It includes RJ45 ports (one-in, one-out) for data line protection, too. You can install the PowerPanel software for real-time monitoring and configuration, or just use it as a big dumb box of electricity.

All six power outlets are surge protected, though the company warns against connecting anything with a large power requirement (i.e. laser printer, heater, vacuum, etc) or else the unit could be damaged. This series of UPS also provides continuous power protection, so if your electrical supply is poor quality it will provide steady power and prevent possible equipment damage from power fluctuations.

The front panel is a colour LCD with a clean and comprehensible design, much better than some rival UPS displays we've reviewed in the past. USB-A and C charging ports are also present, offering 5 V / 2.4 A maximum output.

The batteries inside are lead acid type, which may sound archaic but suits UPS function well. And it makes the unit heavy at 10kg, though that's not really an issue given its probable permanent placement. The does mean recharge time is slow, though, with it needing a full eight hours for topping up after being run down by 90%. The batteries are user-replaceable should the need ever arise.

CyberPower backs up its product with included two year Connected Equipment Guarantee, with coverage up to $75,000.

Overall the CyberPower CP1350EPFCLCD is a basic but well-designed UPS that's good value and ticks the essential boxes. ■

SPECS Phase: Single Phase; UPS Topology: Line-interactive; Active PFC Compatibility; Nominal Input Voltage (Vac): 220, 230, 240; Capacity (VA): 1350; Capacity (Watts): 810; Outlets: 6; USB Charging Ports: USB-A x 1, USB-C x 1; Runtime at Half Load (min): 9.6, Runtime at Full Load (min): 2.1; Network Protection RJ45 1-in, 1-out; Dimensions (WxHxD) (mm): 100 x 281.5 x 354.1; Weight 10kg.

VERDICT

★★★★☆

Everything you need and nothing you don't, in an affordable package that's effortless to run.
Ben Mansill

SPECS 35,000dpi sensor • 140 hours battery life • 5 memory profiles • Wireless USB dongle supplied • Bluetooth • 43x130x75mm (HxWxD) • 112g.

apc HIGHLY RECOMMENDED

PRICE $279 **WEB** razer.com

Razer Basilisk V3 Pro 35K

Clicks into place.

This latest addition to Razer's mouse range looks expensive – and it is – but it's also packed with the latest technology. Its headline feature is a scan resolution of 35,000dpi, making the mouse extremely sensitive. A higher resolution means the mouse is more accurate, making it ideal for playing games, but it's also useful for general Windows use, especially when performing fiddly tasks such as photo editing and working on spreadsheets.

It has a rechargeable battery that Razer claims will last around 140 hours. We tested it for around 100 hours, during which it dropped from 80 per cent charge to 15 per cent, so the claim is well founded.

The unit has 11 programmable buttons, but the most interesting is the scroll wheel. Razer calls this a Smart-Reel, and it switches between smooth scrolling and a clicky, ratcheted feel depending on how you use it. Scroll slowly and the ratchet kicks in for greater accuracy. Scroll faster to flick through a long document, for example, and the wheel spins smoothly.

Features aside, this is a high-quality mouse with a comfortable, ergonomic design that's easy to use. Its clicks are quiet and satisfying, it skims smoothly across your mouse mat, and its HyperSpeed wireless 2.4GHz receiver provides a reliable connection to your PC.

Alternatively, you might want to consider the Logitech Lift Vertical Ergonomic Mouse at $95. It's a cheaper mouse that's also very comfortable to use but doesn't have the same level of accuracy. ■

VERDICT

★★★★½

An expensive mouse, but you get a lot for your money.

APC staff

SPECS USB-C port for power and audio; 3.5mm aux-in; 3.5mm headphone jack; Bluetooth 5.4; 74x410x93mm (HxWxD); 1.04kg.

apc HIGHLY RECOMMENDED

PRICE $79 **WEB** au.creative.com

Creative Sound Blaster GS3

Light music.

You're all probably aware of how much a soundbar can improve the audio quality of a mediocre TV speaker, so it comes as no surprise that one could also enhance your PC's sound setup. The Creative Sound Blaster GS3 is an affordable unit that will beef up your monitor's speakers.

It's very simple to set up, with a USB-C port that can both power the speaker and carry audio. On its right-hand side there's a simple dial for controlling the volume, which we love, and buttons for switching between the three audio-input options (USB-C, Bluetooth and auxiliary). A final button lets you cycle through several lighting options. The front edge has a strip of lights capable of displaying millions of colours, but you have to select one of the default patterns rather than setting your own.

With 24 Watts of peak power from the two built-in speakers, it has more than enough clout to fill a decent-sized room and overall, the sound quality is superb, and certainly better than we were expecting. The bass output is detailed and full, while quieter sounds are handled delicately.

That said, this is still a budget speaker: it doesn't have the richness of, say, a Sonos soundbar, and clarity is occasionally lost with busier gaming soundscapes.

If you're on a tight budget, however, we doubt you'll be disappointed. The build quality is impressive and it sounds great. An alternative would be the Razer Leviathan V2 Pro. At $339 it's much more expensive, but comes with a subwoofer for generating meaty bass. ■

VERDICT

★★★★☆

An affordable soundbar for your computer setup that sounds better than it ought to.

APC staff

apc EDITOR'S CHOICE

PRICE $169 **WEB** raspberry.piaustralia.com.au

Raspberry Pi 500

Just add a monitor and away you go.

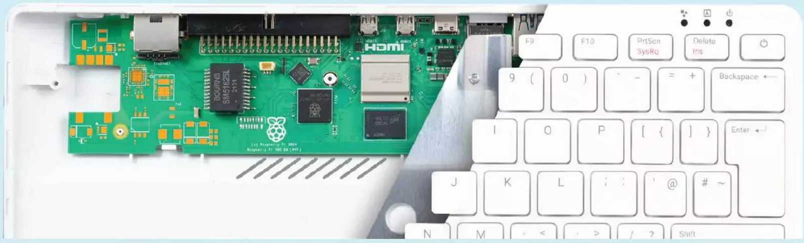
When the Raspberry Pi 400 was released, the world was in the grip of Covid-19 and chip shortages meant that stocks of common electronics were in short supply. That includes the Raspberry Pi 4. This made the idea of a computer in a keyboard all the more enticing, especially as it invoked nostalgia for anyone who used Commodore or Sinclair machines in the 1980s.

First impressions

"It's just a keyboard, right?" is what I thought when I received the Raspberry Pi 400 out of the blue in 2020. For the 400 looks like the official Raspberry Pi keyboard, but while the Raspberry Pi 500 retains a similar form factor, the colour scheme favours all white instead of raspberry red and white used in the 400.

All of the ports sit on the back of the case, including a single USB-A 2 port for your choice of mouse, two USB-A 3.2 Gen 1 ports and a microSD card slot (so the same as the Raspberry Pi 5, which sits inside). The sole USB-C input is only there to supply power, but there are also dual 4K micro-HDMI ports, a GPIO interface and a Gigabit Ethernet port. Finally, there is a spot to lock your Pi 500 to a desk with a Kensington lock.

The keyboard is a perfectly fine membrane offering. Its chiclet keys are responsive and work well even under fast typing. It even has a power button in the top right, but don't fret: it takes a long press to trigger the power off process.



Thermal and power performance

Following in the footsteps of the Pi 400 is no bad thing when we're talking thermal performance. It's all thanks to that huge piece of metal that sits under the keyboard, acting as a heatsink. Passive cooling performance is remarkable, even when overclocked to 3GHz.

First up was the stock speed test. At idle, the system runs at 1.5GHz, and 31.2°C. Despite only having passive cooling, the Pi 500 remained cool even under a full five-minute stress test. Compared to the Raspberry Pi 5's idle temp of 39.5°C (passively cooled using the Active Cooler's heatsink) the Pi 500 is chilly and only sips 2.6W of power.

During the five-minute stress test, all four cores ran at their maximum speed of 2.4GHz and this saw the SoC hit 51°C, 8°C cooler than the Raspberry Pi 5's 59°C. Power consumption under stress hit 6.4W, but that was nothing to worry about.

Buoyed by this success, I pushed the Raspberry Pi 500 to 3GHz and it coped

SPECS 2.4GHz 64-bit quad-core Broadcom BCM2712 Arm SoC; 800 MHz VideoCore VII GPU; 8GB LPDDR4 RAM; Wi-Fi 5; Bluetooth 5; 2 x USB-A 3.2 Gen 1, USB-A 2; 1GbE; 40-pin GPIO header; 2 x micro-HDMI outputs; microSD slot; DSI display port; CSI camera port; stereo output and composite video port; USB-C (power only);286 x 122 x 23mm (WDH); 1yr RTB warranty.

extremely well. I did have to adjust the voltage to keep everything stable, but once I found the magic numbers, the system performed remarkably well. The idle temperature was 33°C, and only 2.65W of power as the CPU was still idling at 1.5GHz. Running the stress test, the CPU hit 3GHz and 65°C, well under the 82°C thermal throttle point. Obviously power consumption went up, to 8.8W, but still well under the 25W capability of the official Raspberry Pi 5 PSU.

The thermal performance of the Raspberry Pi 500 proves that with good passive cooling, the mighty BCM2712 can be tamed.

> "With no support for SSDs, it's inevitable that some aspects of the Pi 500's performance will be held back by the microSD card."

Real-world performance

With no support for SSDs, it's inevitable that some aspects of the Pi 500's performance will be held back by the microSD card. Boot time is still impressive, at 19.9 seconds, but that's in line with other Raspberry Pi branded A2 micro SD cards that I've tested on the Raspberry Pi 5.

Where I see the biggest difference is in read and write performance and I'm sad to say that microSD cards are the slowest way to run a Raspberry Pi. To show this, I compared the performance of the Raspberry Pi 500 to the recent Raspberry Pi Compute Module 5, which has both eMMC and NVMe storage options.

Using dd to read the entire 32GB micro SD to /dev/null, I recorded the Raspberry Pi 500 reaching 89MB/sec; not a slouch, but way slower than NVMe at Gen 3 speed (768MB/sec). Sequential write speeds were recorded using Raspberry Pi Diagnostics, part of the OS. I saw 32MB/sec with the A2 class microSD , while NVMe Gen 3 reaches 703MB/sec.

So does this mean that Raspberry Pi OS on the Raspberry Pi 500 is an awful experience? Not at all; I just would have preferred to have a faster storage option. The branded A2 class cards are excellent, and Raspberry Pi OS was snappy and responsive. I could happily use the Raspberry Pi 500 like this. But deep down in my heart I really wanted a little something extra under the hood.

Just like the Raspberry Pi 400, the Pi 500 needs a breakout board to access the GPIO. Luckily, the pinout is the same, so you can reuse an older breakout board. The port comes covered by a rubber stopper,easily removed with some tweezers. Essentially you will have the same GPIO pins as the Raspberry Pi 5, and because of the changes to how Python software is installed (PEP668) and Raspberry Pi's decision to use the RP1 "Southbridge" for the GPIO, you will have the same experience. All you need to do is use the aforementioned breakout to correctly route the pins for use with a HAT.

Pi 500 use cases

As with the Raspberry Pi 400, the Pi 500 is here to be a 21st century equivalent to the home computers of the 1980s. You plug in to a wedge-shaped keyboard, hook up to your display and start work. But the Raspberry Pi 500 has much more processing power than the Pi 400, and that means it can be a viable desktop computer for those that don't need an RTX 4090 or a power-hungry CPU.

I do have my criticisms, most notably the lack of instant GPIO access, support for PCIe-based storage and camera display ports, but the bottom line is that I really like the Raspberry Pi 500. It's a surprisingly powerful machine in a pleasant package. I'm old enough to remember the 1980s home computer craze, and the Pi 500 reminds me of that time only with much more power. Enough to make this a great all-rounder.

The Raspberry Pi 500 is the kit that you buy as a gift for someone who would never use a bare board, or as a child's first computer. But more than this: I can also see it being used in schools and to an extent in offices around the world. ■

VERDICT

★★★★★

A brilliant update to the Pi 400, with Pi 5 power and superb thermal performance packed into a keyboard.

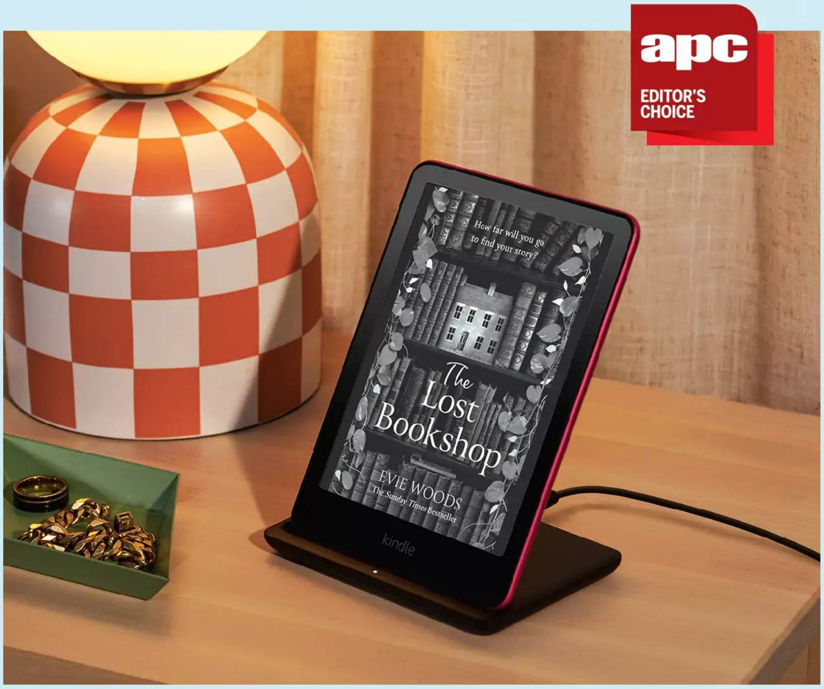
Les Pounder

PRICE $327 **WEB** amazon.com.au

Amazon Kindle Paperwhite Signature Edition (2024)

Minor upgrades add up to a big improvement.

The new Amazon Kindle Paperwhite Signature Edition (SE) has three clear advantages over the plain $299 Paperwhite, which has also just been updated. First, it comes with 32GB of storage rather than 16GB. Second, it supports wireless charging. And third, you aren't hit by any ads. Add an auto-adjusting front light and there really is no good reason to consider the Paperwhite, other than Amazon often slashes its price in flash sales.



Both new Paperwhites use the latest E Ink black-and-white Carta 1300 display. This doesn't offer more sharpness than past Kindle screens, but it does increase contrast ever so slightly. That helps text stand out, making it easier to read without straining. Pictures look surprisingly good in 16 levels of grey.

The visual quality is just as good as previous Paperwhites, and you'll appreciate the extra inch if you're moving up from a 6in Kindle. The front light reaches bright heights, and with an auto-adjusting light sensor it will seamlessly respond to changing conditions in your room. If you're in a well-lit room you won't need any light at all, but those who read in bed and rely on the light will appreciate the full set of amber and white LEDs that eliminate blue light.

Amazon claims that the Paperwhite SE will last for 12 weeks between charges, which assumes that you're reading at half brightness and for half an hour each day. That translates to around 40 hours of screen time, and the battery won't die if you put the book down for a couple of weeks.

For a typical person reading a typical book, that means you should be able to read a couple of novels before you need to recharge the Paperwhite. That's exceptional for any modern electronic device.

These are all nice improvements over what came before, but the biggest difference you'll notice is how quickly the pages turn. That's due to a dual-core processor, which is more than powerful enough to cope with the basic interface. The display also does an impressive job of keeping up with the improved performance inside; I expected to see more ghosting and residual characters as I zoomed in and out of a page, but the new Paperwhite offers a lighter version of screens while panning, before flashing briefly and producing a darker, final version when I stopped.

The only area where the Kindle lags behind modern technology is in touch sensitivity. I still felt a delay between tapping the screen, such as when I needed to enter my Wi-Fi password, and when the character appeared. Menus were faster while I was navigating, but still not totally reliable when tapping through them.

So, should you buy the Paperwhite Signature Edition? If your current offering is tired, then yes. The bigger, better screen alone is reason enough to upgrade. Plus, with an IPX8 rating, it can be immersed in 2m of water for an hour; but note the lack of dust ingress resistance and Amazon's limited one-year warranty. If you aren't locked into the Kindle library of books then it's always worth investigating what Kobo has to offer – the Clara Colour is $68 cheaper than the Paperwhite Signature Edition – but if you're Amazon through and through then this is now the best Kindle out there. ■

SPECS 7in E Ink 16-level greyscale touchscreen; 300ppi; 32GB storage; IPX8 2.4GHz/5GHz Wi-Fi; Bluetooth; USB-C connector; 128 x 7.8 x 177mm (WDH); 214g; 1yr RTB warranty.

VERDICT

★★★★★

A nice boost in performance and a brighter screen.

Philip Berne

PRICE $649 **WEB** amazon.com.au

Amazon Kindle Scribe (2024)

Genuinely useful AI tools make this update difficult to resist, even if the price diminishes its appeal.

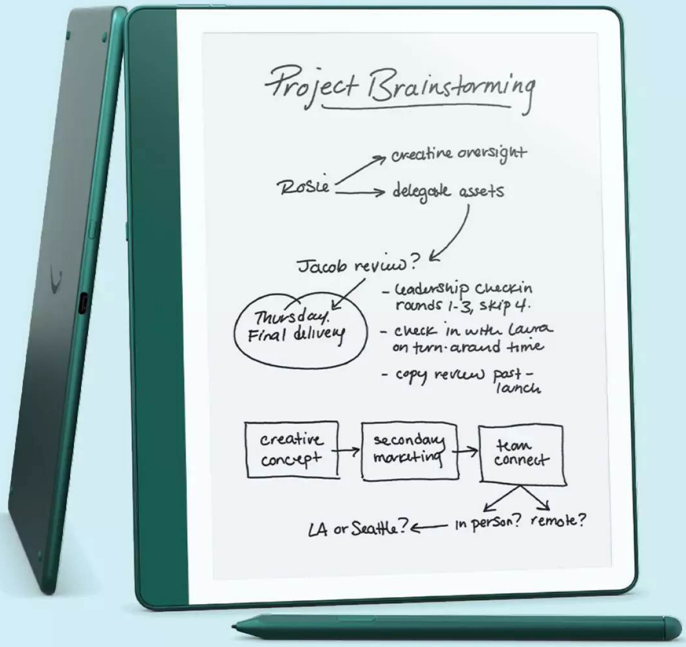
We need to address the obvious: the Amazon Kindle Scribe now costs more than an iPad. It's also almost twice the price of the original 2022 Scribe. But don't turn the page on this note-taking wonder just yet, because there are genuinely strong reasons to buy it.

It's not just a little better than its predecessor, it's a whole new level of better. This is no longer a big e-reader with doodling features tucked away. This is a fully fledged writing tablet, and it does some things better than any other writing tablet I've seen.

The improvements are all down to AI. But don't be put off by the buzzword: it's so good that I almost wish Amazon hadn't told me the Scribe uses AI. I could just think it got much better at handwriting recognition because my writing had improved. Another reason for the price hike is the Premium Pen, which features a rubbery eraser tip. In terms of replicating the feel of writing on paper, the Scribe falls somewhere between the reMarkable 2 and Koba Elipsa. So, a fine writing experience.

The 7in E Ink screen is similar to that of the Paperwhite Signature Edition opposite, but it's worth mentioning its 300ppi text. That compares to 264ppi on an iPad Pro and 226ppi on the reMarkable 2. This is also the brightest writing tablet you'll find, and the light can become warm if you want to read at night and avoid blue light.

> "This is a fully fledged writing tablet, and it does some things better than any other writing tablet I've seen."



But it's the software that makes the new Scribe stand out, including an elegant solution to writing in e-books. Rights issues mean you can't alter the work directly, which Kobo gets around by letting you add annotations – but when you return, you have to be in the same orientation at the same text size. Amazon instead uses a "canvas" tool concept, where the Scribe draws a box on the page in which all your writing is contained; the size of the box is dictated by how much you write. Crucially, the box stays near the point in the page where you added it. This means you can't underline words or circle terms, but it's a great compromise.

Then we come to the AI tricks. First up, handwriting recognition – Amazon calls it refining your notes – which works better than I've seen on any writing tablet before. In fact, the Scribe could read my handwriting better than I could. The second is note summaries. This automatically recognises what you've written and then creates a summary, which is perfect for meetings or classes.

The only annoyance is the delay when you activate the AI tools. The Scribe must communicate with the cloud for every request and response, and it took the Kindle Scribe up to 40 seconds to read a full page of my bad handwriting and return a typed version.

At least the AI's power demands are offloaded from the Scribe, which means you can expect nigh-on identical battery life to the Paperwhite opposite. Reading-wise, that means 12 weeks for half an hour a day. Writing-wise, it's 30 minutes per day for three weeks. Charging is slow, though, taking two-and-a-half hours to go from empty to full using the 9W charger ■

SPECS 10.2in E Ink Paperwhite screen; 300ppi; 8-core 1GHz MediaTek MT8113 SoC; 1GB RAM 16GB/32GB/64GB storage; Wi-Fi 5 Bluetooth 5; battery capacity not stated; USB-C connector; Kindle Premium Pen; 196 x 5.7 x 230mm (WDH); 433g; 1yr limited warranty.

VERDICT

★★★★☆

Is the new Scribe worth the money, when you're basically paying for AI features and a better stylus? I have to say yes.

Philip Berne

PRICE $362 **WEB** corsair.com

Corsair MP700 Elite 2TB

Sort of good value, sort of not.

apc HIGHLY RECOMMENDED

It feels like yesterday that the first PCIe 5.0 SSDs were launching into the public arena. All of them were based on the same hardware setup. Each featured Micron 232-layer TLC NAND, and each packed that with a Phison E26 controller.

On paper they were beasts; 10GB sequentials and high random 4K performance, but boy were they hot. Out of the gate, almost all of the drives had some form of active cooling solution built into them; tiny fans spinning around at ungodly RPMs in an attempt to pull that heat away from the NAND underneath.

We've come a long way since then, and with multiple generations of the tech finally hitting center stage, the bigger manufacturers are starting to produce custom SSD designs on the platform that lean away from that Micron Phison combo. Enter Corsair's MP700 Elite.

Confusingly named, the Elite is meant to be a budget SSD rather than a top-tier flagship. It's been built with that in mind. It doesn't have the maximum blistering sequential speeds of something like Crucial's T705, or even Corsair's own MP700 Pro. No, instead, in its 2TB capacity that we have here, it's limited only to 10GB on the read and 8.5GB on the write – or at least it's advertised at that.

Under the microscope, this thing behaves very differently to pretty much all of the SSDs we've had in previously. Corsair's taking advantage of Kioxia's latest 218-layer BiCS8 TLC NAND flash, combined with Phison's E321T controller. There's no DRAM on the board itself at all, and it's been configured in a single-sided M.2 2280 configuration to ensure wider thermal compatibility with laptops, consoles, and more.

What's particularly interesting about that is how it performs under load. For a PCIe 5.0 drive, this thing is phenomenally chill, quite literally. During our time testing, it didn't hit higher than 55 C, and that was under some pretty aggressive IO Meter benchmark runs. Compare that to something like Seagate's FireCuda 540 at 83 C or Crucial's T700 clocking in at a whopping 87 C, and it does feel like Corsair has managed to circumvent those thermal constraints, thanks to some impressive NAND and a more efficient controller as a result.

Other performance metrics are surprisingly solid, too. Sequential read and write are slightly above what's advertised, but what's more impressive is that the Random 4K performance sits well above pretty much every drive we've tested to date, including the T700.

The problem is the budget mantra that permeates the marketing position of this thing. It's kind of not a budget solution. Crucial's T700, Gigabyte's Aorus Gen5 12000, and even Corsair's own offerings are now often available for lower than the price of this thing. On the surface, $250 for 2TB of solid PCIe 5.0 storage is decent, but with the constant shuffle on NAND pricing continually reducing the overall cost of most of the older, sequentially faster drives, the only reason you'd really be keen to pick one of these up over them is the lower temperatures and possibly the fact that you can remove the heatsink fairly easily (it has Philips screws).

In isolation from the current economic situation, the MP700 Elite is a strong contender, but as soon as you throw any deals or holiday sales into the mix, it quickly becomes far less appetising. ■

BENCHMARK RESULTS	2TB Corsair MP700 Elite PCIe 5.0 M.2 SSD	2TB Seagate FireCuda 540 PCIe 5.0 M.2 SSD	2TB Seagate FireCuda 540 PCIe 5.0 M.2 SSD
CrystalDiskMark 8 Sequential Read/Write - QD8T1 (MB/s)	10,235 / 8,627	10,031 / 10,152	12,299 / 11,770
CrystalDiskMark 8 Random 4K Read/Write - Q18T1 (MB/s)	88 / 336	80 / 319	81 / 315
Final Fantasy XIV Total Load Time (seconds)	7.919	7.754	7.027
3D Mark Storage Bench Score (Index)	3,004	3,887	3,541
3D Mark Storage Bench Bandwidth (MB/s)	507.78	662.98	598.22
3D Mark Storage Bench Access Time (ns)	59	46	50
Max Temperature (Celsius)	55	83	87

VERDICT

★★★★☆

Phenomenal temperature management; Easily removable from heatsink; Decent pricing; Good all-round performance. Sequential performance relatively slow by today's standard.

Zak Storey

apc
EDITOR'S CHOICE

PRICE $1,338 **WEB** www.westerndigital.com

WD Black SN850X 8TB

All of the terabytes all of the time.

We've done it, people; we've hit maximum SSD. 8TB of gloriously fast NAND flash baked into a single M.2 stick. Let's be clear: from a purely practical perspective, it's hard to justify a drive like this. On the one hand, yes, you can store a lot of data on it; on the other, if you did hypothetically fill up 70 percent of it, if that drive failed without a backup, you'd be in a world of hurt. It's a lot of capacity to house on a single stick, that's for sure.

WD's not pulling its punches. The SN850X initially launched at the tail end of 2022. However, its maximum capacity was limited to a paltry 4TB. This modern SN850X, however, is a different beast. WD's managed that by significantly improving the NAND flash in this stick. It's shifted up to Kioxia's 162-layer BiCS6 TLC instead – a far denser and more efficient NAND. Yet, the controller actually remains the same, all in all; it's still WD's proprietary solution (aptly named the Triton MP16+B2).

Advertised performance is similar, too; however, sequential performance has taken a hit, with reads falling from 7,300 MB/s on the 4TB to just 7,200 MB/s on the 8TB unit (likely a decision to limit heat build-up). Random write IOPS have also seen a slight uptick, being bumped up by an additional 100K.

Performance is solid under test conditions; those sequentials fell right on the money or thereabouts; they were low in CrystalDisk, sliding in at 7,136 and 5,585 MB/s respectively, and random 4K performance wasn't mind-blowing at just 72 and 298 MB/s, but that's a relative metric compared to similar drives – a 3-5 percent differences in most cases.

Temperatures remained comfortable for a PCIe 4.0 drive, resting at just 63 C. Compare that to something like WD's own 4TB Blue SN5000 (81 C), and this is remarkably cool by contrast. It even beats some of the competition, giving Samsung's latest efficiency-driven 990 Evo Plus line a run for its money (and that's comparing a 1TB option to an 8TB).

All that aside, who is this drive for? Is 8TB (7.27TB in Windows) nice to have? Yes. You can download loads of Steam games and still have room to spare. But that's serious GPU money, and given how rapid modern internet speeds are, you need to be able to justify that cost as being absolutely necessary and worth avoiding the inconvenience of deleting and re-downloading programs you need.

For creatives and data analysts, there's another good argument for it in terms of a backup, but again, you're putting all your trust in a single drive. Although WD does have a solid reputation in the endurance market, drives can still fail. Even 4TB pushes that concept a touch further than we'd feel comfortable.

Our takeaway is simple: this is a sea change. Look at the pricing, compare that to the initial 4TB drive, and see how that's fallen over the last two years. These drives are becoming more affordable. Flash-forward 700 days, and it's likely this will be $600 or so. If that's the case, then although this might be a bit of a stretch today, perhaps in a few years, you should be considering this as your PC's next solid-state home. ■

BENCHMARK RESULTS	8TB WD Black SN850X PCIe 4.0 M.2 SSD	4TB WD Blue SN5000 PCIe 4.0 M.2 SSD	1TB Samsung 990 Evo Plus PCIe 4.0 M.2 SSD
"CrystalDiskMark 8 Sequential Read/Write - QD8T1 (MB/s)”	7,136 / 6,585	5,511 / 5,054	7,081 / 6,238
"CrystalDiskMark 8 Random 4K Read/Write - Q18T1 (MB/s)”	74 / 299	79 / 296	68 / 232
Final Fantasy XIV Total Load Time (seconds)	7.26	6.638	8.044
3D Mark Storage Bench Score (Index)	2,970	2,915	2,980
3D Mark Storage Bench Bandwidth (MB/s)	504.8	502.43	508.26
3D Mark Storage Bench Access Time (ns)	57	63	61
Max Temperature (Celsius)	63	81	59

VERDICT

★★★★½

Strong all-round performance; New denser NAND; PS5 compatible with heatsink; Surprisingly cool. Slightly slower sequentials.

Zak Storey

NEEDS Windows 10 or 11 , macOS, Linux, Android or iOS **WEB** https://localsend.org

LocalSend 1.16.1

File-sharing tool

Sharing photos, videos, documents and other files between your PC and phone usually involves either sending them as email attachments or uploading them to an online-storage service. LocalSend offers a much easier solution by letting you share files directly across your Wi-Fi network, without using an intermediary service.

It works in the same way as Apple's AirDrop feature and Google's Quick Share, but is cross-platform, which means it works across Windows, macOS, Linux, Android and iOS devices. LocalSend is completely free to use and you don't even need to sign up for an account.

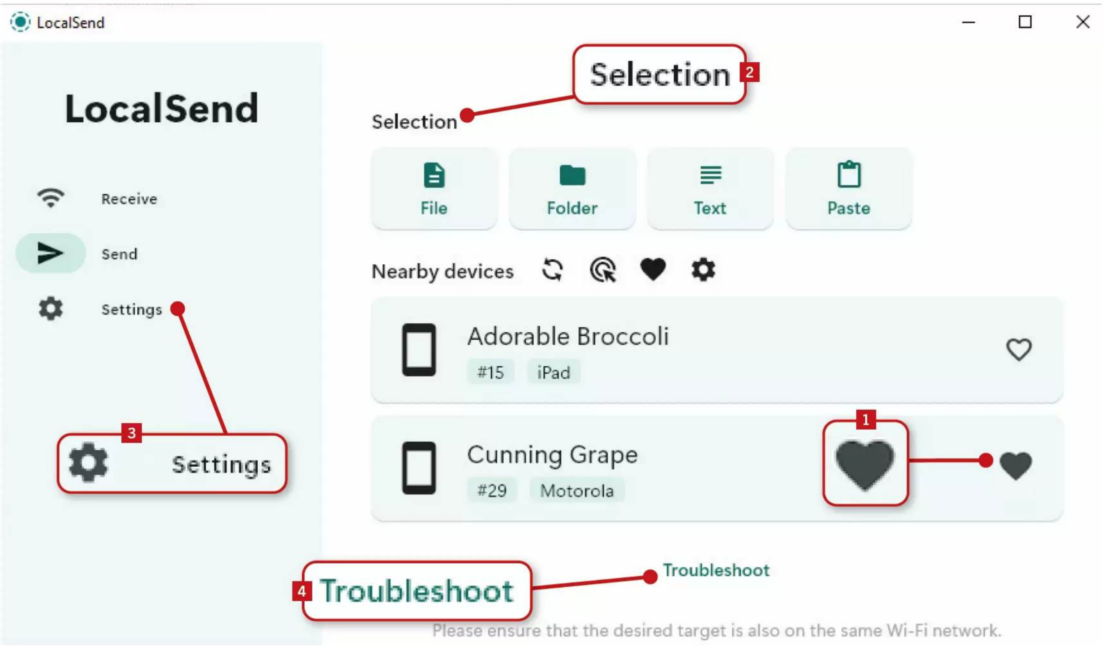
Simply download the Windows program from **https://localsend.org/download**, and install the LocalSend app for Android (**tinyurl.com/APC542local**) or iOS (**tinyurl.com/APC542localio**) on your phone. Provided the devices are connected to the same network, they will recognise each other's codenames, which are themed around fruit and vegetables.

You can then send files and folders from your PC to your phone – and vice versa – with a single click or tap. On the receiving device, click or tap Accept to complete the transfer, and save the shared item to your Downloads folder or media library.

The latest version of LocalSend improves the transfer speed at the sending device's end and adds a button to retry failed transfers. It also lets you receive only files from 'favourite' devices when the Quick Save feature is active. This prevents strangers from sending you items if they somehow access your network. To enable the new option, click Settings and – in the Receive section – switch on 'Quick Save for Favorites'.

Another improvement affects the Auto Finish feature, which automatically closes completed transfers so you can send more files. This now only works when a file is successfully received (or declined) at the other end.

Additionally, you can now show or hide LocalSend's 'Advanced settings'. These let you change the displayed device type and disable encryption (which is not recommended), among several other useful tweaks.

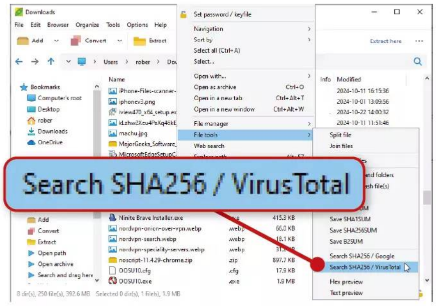


1 LocalSend will automatically detect devices with its app installed and open, provided they're connected to the same Wi-Fi network. Add these trusted devices as favourites by clicking the heart icons next to their fruit-and-veg-themed names.

2 Click one of the buttons under Selection to choose the type of item you want to share. As well as sending files and folders to nearby devices, you can click Text to send a message or Paste to copy content from the Windows clipboard.

3 Go into LocalSend's Settings to configure how the program looks and works. You can change its colour scheme, switch it to dark mode, set it to run on Windows startup and enable its Quick Save and Auto Finish options.

4 If the LocalSend app on your phone can't detect your PC, you probably need to tweak the Windows firewall. Click 'Troubleshoot' then 'Fix automatically' and LocalSend will allow incoming connections through the required firewall port.

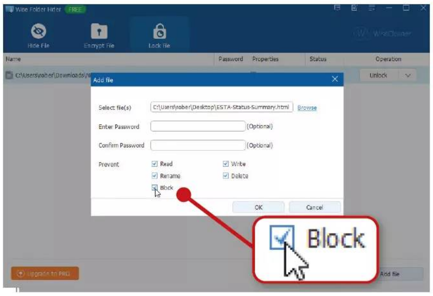

Search SHA256 / VirusTotal
Set password / keyfile
Navigation
Sort by
Select all (Ctrl+A)
Select...
Open with...
Open as archive
Open in a new tab
Open in a new window
File manager
File tools
Web search
Split file
Join files
Save SHA1SUM
Save SHA256SUM
Save B2SUM
Search SHA256 / Google
Search SHA256 / VirusTotal
Hex preview
Text preview
Extract here

COMPRESSION TOOL

PeaZip 10

WEB https://peazip.github.io **NEEDS** Windows 7, 8.1, 10 or 11, macOS or Linux

PeaZip 10 expands the number file types supported by the compression tool to 234, and gives it a fresh – but not radical – new design. This tidies up the menus, simplifies the program's icons, makes the interface look less cramped and updates its themes. The default theme is a rather dull grey affair, but you can change this by clicking the three-dot icon in the top-right corner and choosing Settings, then Theme. The most notable new feature is the ability to scan files for malware using VirusTotal.com, to stop dodgy downloads infecting your PC. Right-click an item and select 'File tools' then 'Search SHA256/VirusTotal' (see screenshot) to upload the file to VirusTotal and check whether any antivirus engines flag it as malicious. PeaZip itself triggers a SmartScreen warning, but it's safe to use, so just click 'More info' then 'Run anyway'.


Block
Wise Folder Hider
Hide File
Encrypt File
Lock File
Add file
Select file(s)
Enter Password
Confirm Password
Prevent
Read
Write
Rename
Delete
Block
OK
Cancel
Browse
(Optional)
Unlock
Upgrade to PRO
Add file

PRIVACY TOOL

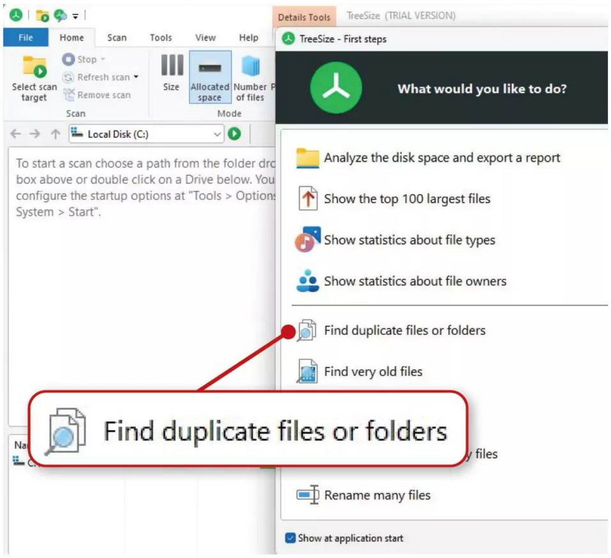
Wise Folder Hider 5.0.6

WEB www.wisecleaner.com/wise-folder-hider.html
NEEDS Windows 7, 8.1, 10 or 11

Wise Folder Hider lets you hide sensitive files, folders and even entire USB sticks from prying eyes. You can also lock items, so they're still visible but can't be opened without a password, and add them to an encrypted locker – though the free version limits you to encrypting 50MB of data. The latest update adds the option to stop locked EXE files running, until they're unlocked through Wise Folder Hider. When you lock a program file, tick the Block box in the Prevent section (see screenshot) before clicking OK. If someone tries to run the EXE, they'll see an error message saying: 'The specified path does not exist'. Another new feature lets you unhide and unlock items in Wise Folder Hider simply by double-clicking them. The software itself is protected with a password to prevent unauthorised access.

Should I pay for?

Choose the right version of software


Find duplicate files or folders
File
Home
Scan
Tools
View
Help
Details Tools
TreeSize (TRIAL VERSION)
Select scan target
Stop
Refresh scan
Remove scan
Size
Allocated space
Number of files
Mode
Local Disk (C:)
TreeSize - First steps
What would you like to do?
Analyze the disk space and export a report
Show the top 100 largest files
Show statistics about file types
Show statistics about file owners
Find duplicate files or folders
Find very old files
Rename many files
☑ Show at application start

To start a scan choose a path from the folder drop-down box above or double click on a Drive below. You can configure the startup options at "Tools > Options > System > Start".

TreeSize Personal

WEB www.jam-software.com/treesize **PRICE** €25.95 (~AUD$43)
FREE TRIAL 30 days **NEEDS** Windows 10 or 11

Similar to WinDirStat (**https://windirstat.net**), TreeSize is a disk-space analyser that reveals which files and folders take up the most room on your PC. Unlike that program, it offers a choice of Free, Personal and Professional editions, with the latter aimed at businesses.

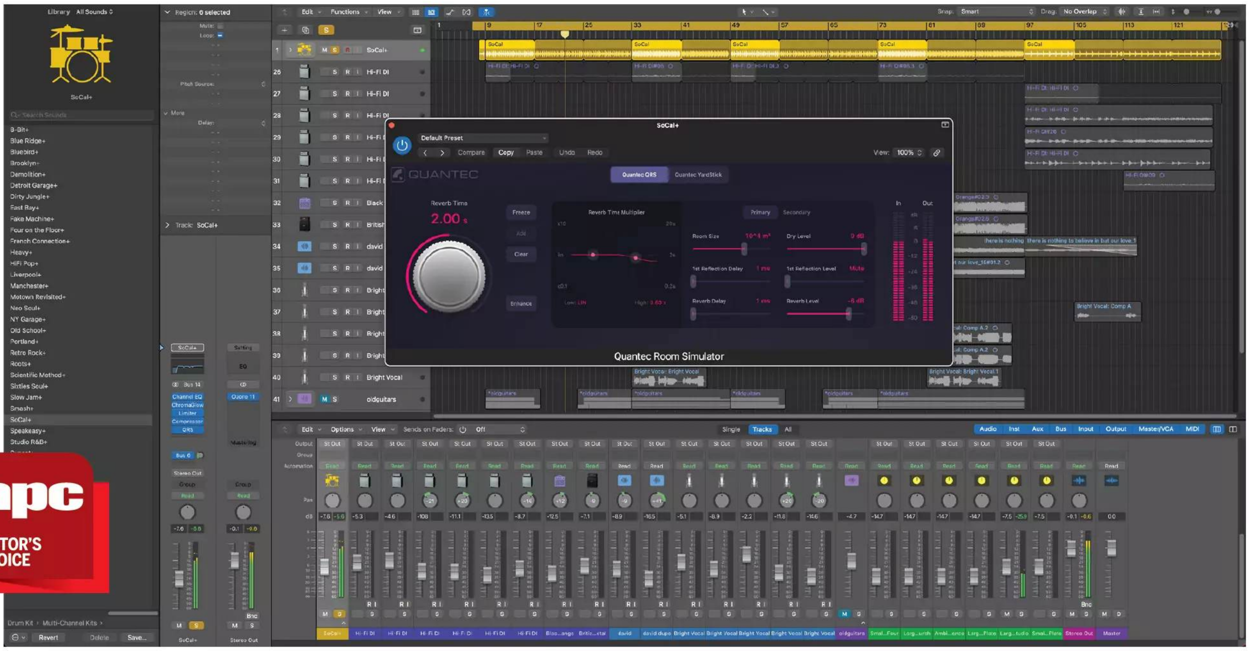
Unsurprisingly, TreeSize Free is the simplest to use, automatically scanning your main hard drive to detect how much space files and folders are consuming. It displays its results as both a list of items (from largest to smallest) and a 'tree map' that presents the information visually in the form of proportionately sized blocks – click the View tab then Show Treemap Chart to see this.

In contrast, TreeSize Personal offers a choice of modes: Expert, Normal and Simple (which is closest to the free version). Choosing 'Normal' opens a list of options that are only available in the paid-for edition. These include showing the largest 100 files on your PC, scanning for duplicate files and folders (see screenshot), and finding and deleting temporary files. You can also choose which drive or folder to scan – including an online-storage or network drive.

The results are much more detailed than in TreeSize Free, which is useful for forensic analysis of disk-space usage, but also makes the interface rather cramped and confusing. Tools such as 'Send by email', 'Create snapshot' and 'Schedule this scan' are surplus to requirements, when you just want to find and remove space hogs.

OUR VERDICT: DON'T PAY FOR IT

The free version of TreeSize is more than sufficient for detecting and deleting large files and folders. The Personal version has several handy extras, but some – such as duplicate removal – are available for free from rival tools WinDirStat and WizTree (**https://diskanalyzer.com/download**). ■



The new Quantec Room Simulator is an exceptionally good reverb based on hardware you can't afford!

PRICE $299.99 **NEEDS** macOS 14.4 or later **WEB** apple.com/au

Logic Pro 11.1

Our favourite audio app just got even more amazing.

Logic Pro is one of the world's most popular digital audio workstations (DAWs), and it's also one of the world's best software deals: we bought a copy in 2007 and that's meant 17 years of free upgrades, both major and minor.

The upgrade builds on the very solid foundations of Logic Pro 11 and adds Quantec Room Simulator, Plug-in Search (a big time saver), and a host of improvements that'll feel very welcome to serious Logic users. Those improvements include the much-wanted ability to re-order the channel strips in your mixer; the ability to quickly share your mix to Voice Memos for easy previewing on iPhone, iPad or Apple Watch; easier plug-in removal; and a new sound pack called Modular Melodies that's packed full of synth patches.

Those improvements alone would make the upgrade worth having, but the big news here is that Room Simulator. It's a faithful recreation of the world-famous digital reverb hardware, and according to Apple it's one of the most acoustically accurate reverb simulations ever made. Peter Gabriel, who knows a thing or two about recording, says that "it's wonderful" to have it as a plug-in. Original Quantec hardware sells for terrifyingly large sums, and according to audio bible Sound On Sound its algorithms have "arguably, never been surpassed".

Quantec Room Simulator uses the original Quantec algorithms and is useful not just for music production, but for any kind of audio. The interface is nice and straightforward, making it easy to adjust the room size, tweak the low and high end, handle reflections and so on. And the results are extraordinary. Even the best reverbs tend to sound like you're using a reverb, but QRS sounds like you're in a real room. It's absurdly easy to adjust the ambience without making it sound overly processed (unless that's the effect you're going for).

The room simulation isn't just useful for musical ambience – it's great on live drums and Drummer tracks – but for practical challenges such as getting audio from multiple recordings, such as different takes or different locations, to sound consistent and cohesive.

Even before this upgrade, Logic Pro was exceptional value for money and a five-star recommendation. The Room Simulator is a welcome addition to what's already an audio production powerhouse. While it's not going to be a must-have for everyone, it's going to delight audio pros. Yet, despite its power, Logic Pro remains friendly enough to be a great GarageBand upgrade too. ■

> "The interface is nice and straightforward, making it easy to adjust the room size, tweak the low and high end, handle reflections and so on."

VERDICT

★★★★★

Logic Pro is exceptional value for money. It's an audio production powerhouse.

Carrie Marshall

DEVELOPER FunOS Team **WEB** https://funos.org **LICENCE** Mainly GPL

FunOS 24.04.1

Nate Drake shares the delights of this Ubuntu-based distro, using the lightweight JWM. Does anyone else think it should be called Funbuntu?

Successive versions of this Ubuntu-based distro have been released since January 2024. However, its focus is on stability, so the latest versions are based on LTS (Long Term Support) releases of its parent OS.

FunOS also stands out as it abhors a traditional desktop environment in favour of JWM. The developers claim this results in fast and responsive performance.

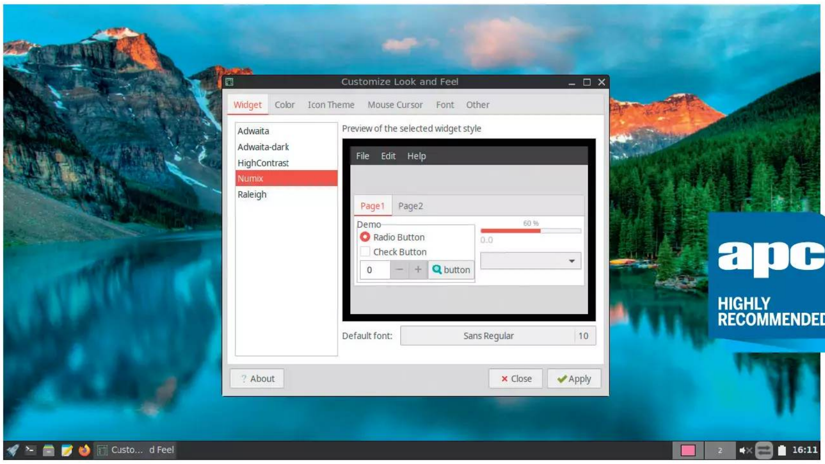
We used the link on the main site to download the 1.9GB ISO from SourceForge. As we did so, we read through the release notes, which state that FunOS 24.04.1 ships with Linux kernel 6.8.0-41. This is consistent with Ubuntu 24.04 LTS, as even though this kernel has theoretically reached its end of life, Canonical maintains its own patched version.

The developers also pride themselves on making FunOS Snap-free. They claim this makes for faster application startup times, more efficient disk space usage and better user control over updates.

Upon first boot, we clicked on Try FunOS, and the live environment loaded in under two seconds. Menus opened at blazingly fast speeds. The latest version of FunOS has also been upgraded to use the Papirus icon theme, which gives the desktop a polished feel.

While none of said icons appear on the desktop, the system tray has been updated to include frequently used apps. The defaults are logically selected, including Terminal, the lightweight PCManFM file manager and Firefox ESR. FunOS's online documentation lists instructions for adding further apps.

FunOS also bundles the Ubiquity installer. As with stock Ubuntu, Ubiquity supports downloading updates during setup, installing third-party software and full-disk encryption.



Default font: Sans Regular 10

apc HIGHLY RECOMMENDED

Despite using JWM in place of a traditional desktop environment, FunOS's interface is highly customisable with alternative themes and colours.

After selecting our partition and user account, setup completed in just under five minutes – one of the fastest we've seen for a graphical Ubuntu-based OS.

This super loading time carried over upon restart, as the FunOS desktop loaded in less than 10 seconds.

While the online documentation includes helpful step-by-step instructions on installing the OS, the system requirements aren't listed beyond a claim that FunOS only uses around 25MB of RAM when idle.

After firing up Task Manager, we found that FunOS was indeed using only 228MB of RAM and around less than 1% of CPU resources on our virtual machine. The install footprint was over 6.5GB.

Although FunOS is Snap-free, there doesn't seem to be any alternative package manager included; nevertheless, we were able to install Synaptic via the command line.

If you do choose FunOS, you probably will also want to do this. There's only a minimal selection of preinstalled apps, with no dedicated email client or office suite. Still, we were able to install Claws Mail via Synaptic in moments. The app also appeared in the Internet menu category after we chose Reload Menu.

Despite a piecemeal approach to package management, FunOS offers a highly customisable interface. The default Numix theme can be tweaked via the dedicated menu. Options include Military and Pretty Pink. After choosing the latter, we noted that menu options were now highlighted in hot pink. You can also select Customise Look And Feel to choose alternative themes, including Adwaita and Raleigh.

If you don't care for the default wallpaper of workers toiling in Vietnamese tea fields, there are 25 alternative backgrounds. You can customise the interface further via the LightDM GTK Greeter, which enables you to select alternative backgrounds, as well as icon and system themes on boot. ■

> "FunOS also stands out as it abhors a traditional desktop environment in favour of JWM. The developers claim this results in fast and responsive performance."

VERDICT

★★★★☆

FunOS leaves other Ubuntu-based distros in the dust, thanks to harnessing JWM. The interface is also simple to navigate.

Nate Drake

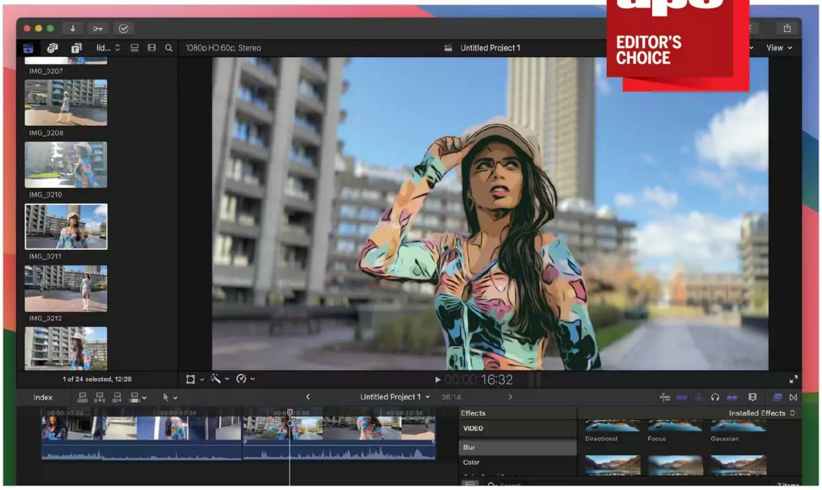
PRICE $499.99 **NEEDS** macOS 14.6 or later **WEB** apple.com/au

Final Cut Pro 11

Get up to speed on the powerful and smart new tools.

Back in June of 2011, Apple's professional non-linear editor (NLE) Final Cut Pro became Final Cut Pro X. Over the following decade, Final Cut Pro removed the X from its title, but its toolset evolved to become a more useful resource for professional video editors. The Final Cut Pro 11 release deserves its full new version number as it boasts much more than a few tweaks to existing tools. As you'd expect with a new Apple product, Apple Intelligence has been used to give Final Cut Pro 11 a big upgrade – speeding up tedious tasks with smart artificial intelligence (AI) powered tools.

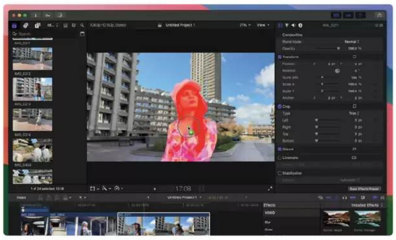
Let's start with the most useful new AI feature – Magnetic Mask. Traditionally a video editor could film a subject against a green backdrop and then, using keying tools, replace the green with footage from a lower layer in the timeline. If your subject wasn't filmed against green screen then you would have to use a pen tool to draw a mask around their outline. The act of drawing a mask (rotoscoping) could be very time consuming and, if the subject walked across the frame, you had to move the mask's multiple control points manually and animate their movement with key frames. The new Magnetic Mask tool is outstanding. Simply click on a person (or drag an effect on to them) and Apple Intelligence creates a mask around them for every frame. You can use brush tools or add control points to modify the mask but in our test we didn't need to. Magnetic Mask was able to isolate our subject's windblown hair – something that the old school green screen technique would struggle with. The Magnetic Mask tool produces a 'wow' inducing effect when you first try it. If you're a compositor, this smart tool will save


Use AI to isolate a moving person (or object) from their background in seconds and add a creative effect to them.

apc EDITOR'S CHOICE

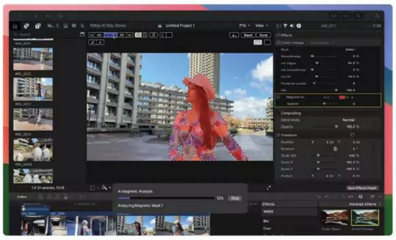
> "The new Magnetic Mask tool is outstanding. Simply click on a person (or drag an effect on to them) and Apple Intelligence creates a mask around them for every frame"

App tips Add, analyse and fine-tune in Final Cut Pro 11



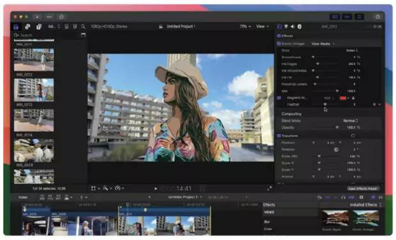
Add an effect

Drag a clip into the timeline. Drag an effect (such as Comic Vintage) from the Effects browser on to your subject in the Viewer. Adjust the position of the cursor until the entire person (or object) becomes selected in red.



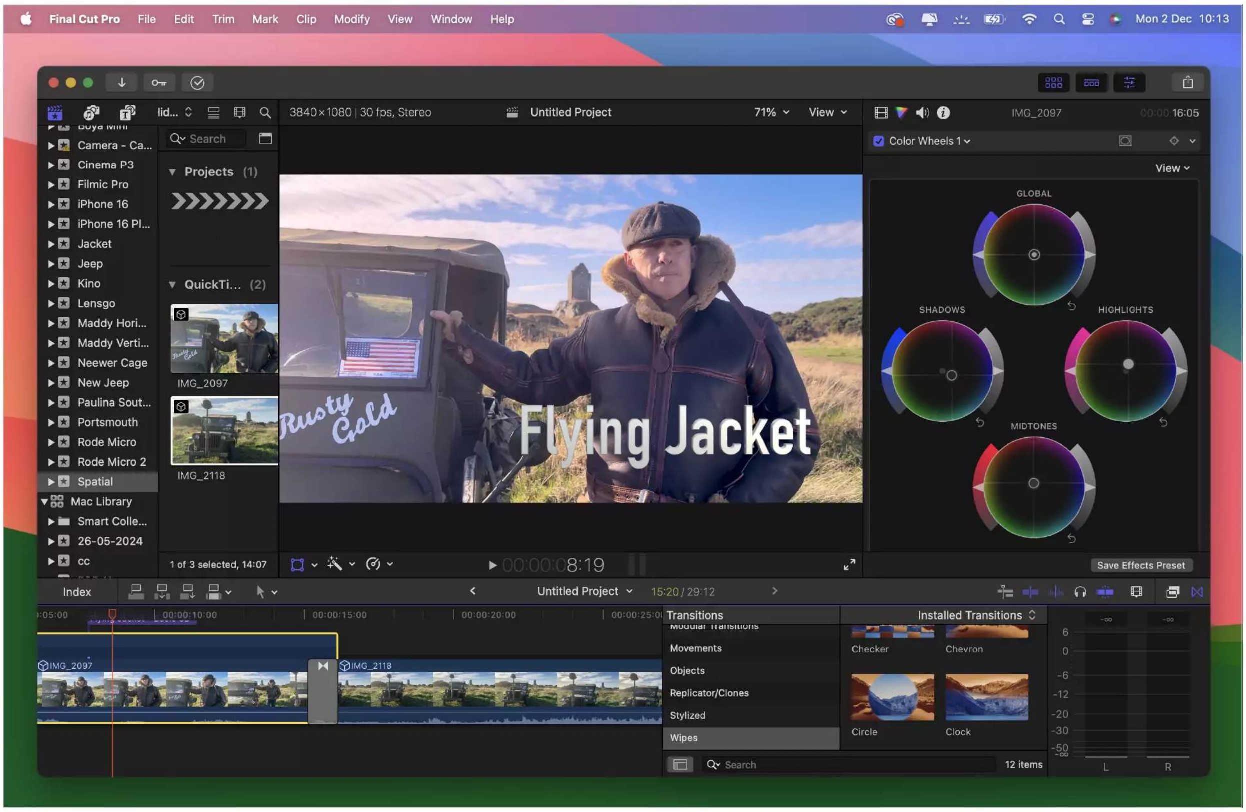
Analyse frames

Press the Analyze button in the Viewer. Final Cut Pro 11 will add a Magnetic Mask to your subject in every frame. You can fine-tune any missed (or unwanted) sections in specific frames by using the add or subtract brush tips.



Fine-tune feather

Click Done. Now the Magnetic Mask will ensure that the Comic Book effect is only applied to the moving subject in the clip. If necessary you can fine-tune the mask's feathered edge in the Magnetic Mask section of the Inspector.


Final Cut Pro
File
Edit
Trim
Mark
Clip
Modify
View
Window
Help
Mon 2 Dec 10:13
3840×1080 | 30 fps, Stereo
Untitled Project
71%
View
IMG_2097
Color Wheels 1
GLOBAL
SHADOWS
HIGHLIGHTS
MIDTONES
Save Effects Preset
Projects (1)
QuickTi... (2)
IMG_2118
Camera - Ca...
Cinema P3
Filmic Pro
iPhone 16
iPhone 16 Pl...
Jacket
Jeep
Kino
Lensgo
Maddy Hori...
Maddy Verti...
Neewer Cage
New Jeep
Paulina Sout...
Portsmouth
Rode Micro
Rode Micro 2
Spatial
Mac Library
Smart Colle...
26-05-2024
cc
1 of 3 selected, 14:07
00:00:08:19
Rusty Gold
Flying Jacket
Index
15:20 / 29:12
Transitions
Installed Transitions
Movements
Objects
Replicator/Clones
Stylized
Wipes
Checker
Chevron
Circle
Clock
12 items
Search

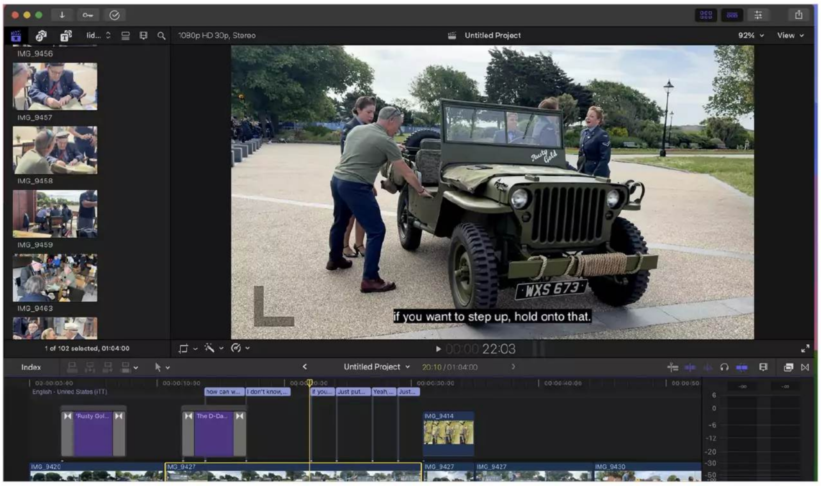
iPhone-sourced Spatial clips can now be edited, graded and titled for viewing as a narrative on the Apple Vision Pro.

you many hours of time.

AI means that another tedious time-consuming task is now a thing of the past – transcribing. If you're an old-school Final Cut Pro editor, then you'll know that it can take days to play your footage bit by bit, and slowly type text into a field above the timeline. Apple Intelligence enables you to quickly create subtitles (or a closed-caption file to upload to YouTube). Simply click on a clip and choose Edit > Transcribe > 'Transcribe to Captions'. In a few seconds your clip's dialogue will be converted into text. As with all AI transcriptions you may need to tidy up a few errors.

What was really interesting in our test was how the clip dealt with a scene featuring overlapping background dialogue. Final Cut Pro 11 was able to prioritise the transcription of the person wearing a wireless mic (who's voice was therefore the loudest). Background voices were only transcribed when the presenter wasn't speaking. This is a fine example of intelligent listening!

Owners of the iPhone 15 Pro, 15 Pro Max and any iPhone 16 model are able to shoot spatial (3D) videos for viewing on the Apple Vision Pro. However, until the release of Final Cut Pro 11, you could only trim the duration of spatial clips on your iOS or macOS version of Photos. Now though, video editors can create complete narratives with extra depth to be enjoyed on the Apple Vision Pro. You can edit spatial clips together in Final Cut Pro 11's timeline and grade them to change colour and tone while preserving the depth metadata that the Apple Vision Pro requires to display 3D footage. 3D editing support, and AI-enhanced masking and transcribing, are exciting examples of how Final Cut Pro 11 is staying on top of the post-production video-editing curve. If you want to check out these amazing new tools, Final Cut Pro 11 is available to try for free for 90 days. ■


1080p HD 30p, Stereo
Untitled Project
92%
View
IMG_9456
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IMG_9459
IMG_9463
1 of 102 selected, 01:04:00
00:00:22:03
Index
Untitled Project
20:10 / 01:04:00
English - United States (iTT)
Rusty Gol...
The D-Da...
IMG_3414
IMG_9420
IMG_9427
IMG_9430

if you want to step up, hold onto that.

A powerful AI language model reduces the time and tedium of manually transcribing speech when creating captions.

VERDICT

★★★★★

If video editing is your 'bread and butter', the new AI tools will save you hours of time.

George Cairns

WIND in 2025

With the new year bringing the curtain down on the most used version of Windows, **Barry Collins** explores where consumers and businesses should head next.

It's remarkable to think that a decade after its release, Windows 10 will enter 2025 as by far and away the most used version of Windows.

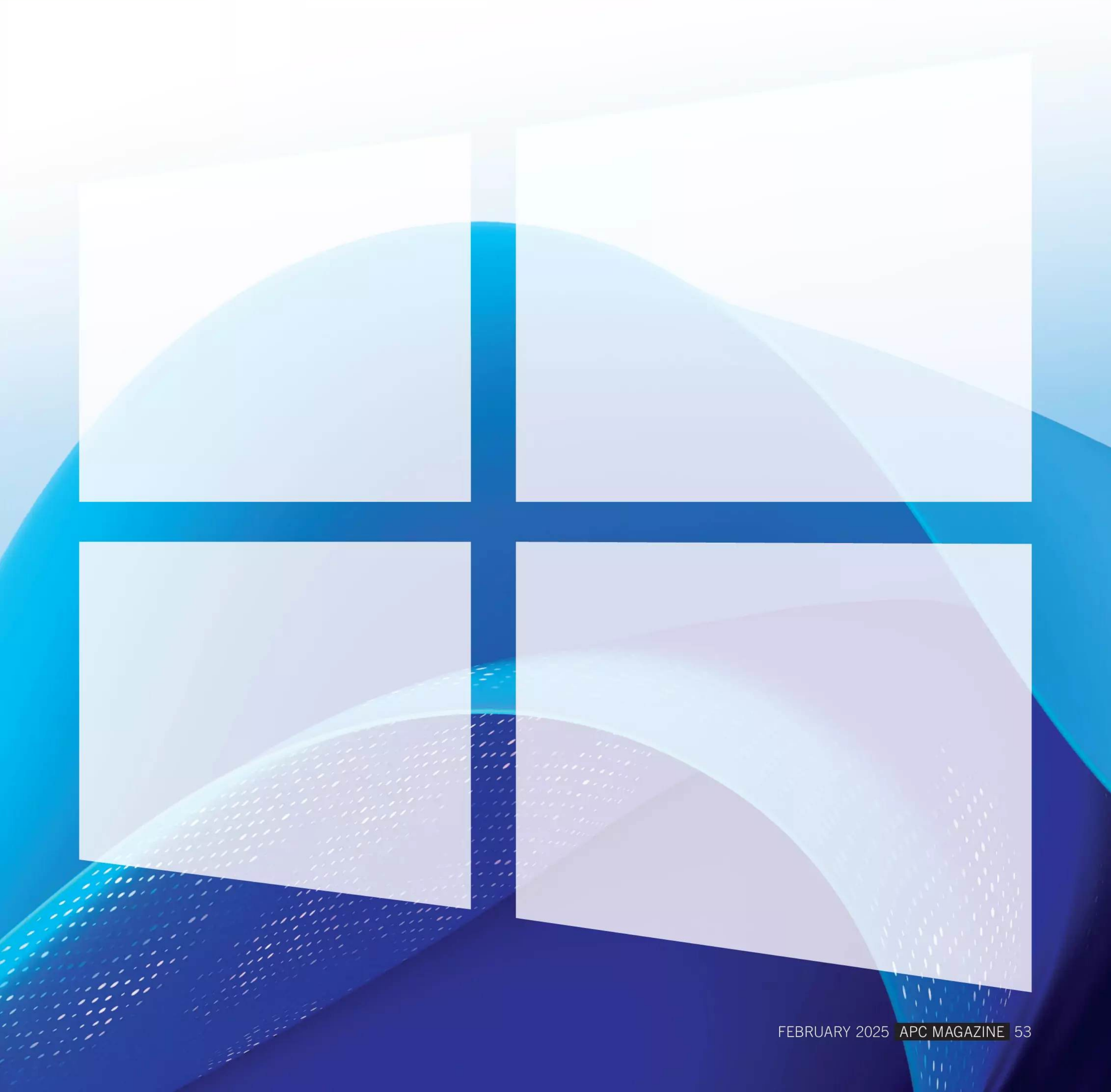
In some ways, it's a cause for a celebration. It shows that the majority of people still find Windows 10 suitably equipped for their computing needs and see no compelling reason to add to the mountains of e-waste by upgrading their computer. A win for the environment.

However, Microsoft is preparing to call time on Windows 10, with the operating system reaching end of support later this year. That will give consumers and businesses a decision to make.

Do they continue to cling to their Windows 10 hardware, grudgingly paying Microsoft for extended support? Do they upgrade to Windows 11 and, if so, which version: x86 or Arm, Home or Pro? Or should they wait for Windows 12, or maybe even eschew the very notion of running their own Windows installations and head for the clouds of Windows 365 instead?

In this feature, we'll systematically go through the options, taking the different operating systems in turn and helping you to decide which version of Windows you should be running in your home or business in 2025.

OWS



WINDOWS 10

The clock is running down on Windows 10 as we enter 2025. Support comes to a halt at the end of October, and although Microsoft has pushed Windows support deadlines back in the past – particularly when that operating system remains in widespread use – the company seems more determined to draw a line in the sand with Windows 10. Not least because there's a revenue stream attached to it.

Have no doubt: there's still a huge installed base of Windows 10 users out there, even though Windows 11 is now more than three years old. The global figures from Statcounter show Windows 10 still accounts for just over 60% of all Windows installations as of October 2024. Windows 11 is at 36%, and while the gap between the two is narrowing, it's not doing so at any great pace.

Perhaps more alarmingly for Microsoft, even the traditional early adopters of new operating systems remain stubbornly attached to Windows 10. Gamers tend to have higher spec machines than average, but Steam's hardware survey for October 2024 found that Windows 10 was still installed on 47.5% of all machines used to access the gaming service, only a tiny fraction less than the 48.8% using Windows 11.

This vast installed base partly explains why, for the first time in the history of Windows, Microsoft is offering Extended Security Updates (ESU) to consumers as well as businesses for Windows 10. Consumers will be given a year's extra security updates for a one-off fee of $30, effectively pushing the support deadline back to October 2026. Microsoft has confirmed to *APC* that its Windows Defender antivirus will also keep receiving updates until at least October 2028.

As was the case with Windows 7, businesses can get up to three years of security patches for Windows 10, but there's a stiff financial penalty for companies that choose to linger on the operating system for the full duration. The first year of updates will cost business customers $61 per device, but that price doubles each year thereafter, meaning that by year three you'll be paying $244 per device for the security updates.

There's no financial advantage to biding your time and only paying for the ESU if a major security breach emerges that you absolutely must patch, either. If you decide to join the ESU in year two or three, you still need to pay the fee for any previous years as well.

That still won't deter many businesses from sticking with Windows 10, according to Wes Miller, research analyst with Directions on Microsoft, which offers independent IT planning advice. Miller predicts most businesses will "defer and delay".

"It's past time for organisations to begin moving to [Windows] 11," he said. "In the long run, they must get to 11, which will likely mean new hardware for many PCs."

Miller believes there are multiple reasons for businesses not moving up the Microsoft food chain. They're not upgrading to Windows 11 as "it often means replacing PCs, when organisations are being told to do more with less. Application compatibility may be to blame for some roles. Lastly, I think some organisations don't like how Windows 11's UI shifts even more and even faster than 10 did."

Upgrade options

As Miller points out, the solution for many Windows 10 users – be they consumers or businesses – isn't as simple as finally biting the bullet and pressing the button to upgrade to Windows 11.

Windows 11 famously raised the minimum system requirements significantly, meaning that a lot of Windows 10-era hardware simply

BELOW Windows 10 has been one of Microsoft's most successful OSes.

Suggested
Microsoft Mahjong
Free
A
Afterlight
Allrecipes
C
Calculator
Calendar
Camera
D
Dragon Mania Legends
Dropbox
E
Edmodo
Excel 2016
G
Welcome Daniela!
How can I help you today?
Cortana
Mike Kong
School Project
Notes
Mail
20
Photos
Sunny
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88°
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Los Angeles
Store
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Ask me anything
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8/18/2017

isn't compatible with Windows 11. At a consumer level, there are workarounds where you can brute-force Windows 11 on to an incompatible machine. For example, the Rufus utility (rufus.ie), which creates bootable USB drives, has an option for Windows 11 installations that removes the requirement for 4GB+ of RAM, Secure Boot and a TPM 2.0 module. However, while you can probably live without the Secure Boot and TPM security, trying to run Windows 11 on a system with 4GB of RAM or less would be... brave.

Legacy software/hardware that isn't compatible with Windows 11 is another potential blocker. Windows 11 Pro allows you to virtualise a Windows 10 instance using Hyper-V, among other virtualisation options, but that is something of a sticking plaster option.

Ultimately, the end of support for Windows 10 really should be the nudge to start considering longer-term solutions. The question is, where to next? Windows 11 is now well established, but there are different versions to consider, including the much improved Windows on Arm. Or perhaps the cloud-based Windows 365? And is there any prospect of Windows 12 any time soon? We'll consider all of these in turn.

The Honeyball view on Windows 10

We asked Jon to give his very personal view on what to say to people who are still relying on Windows 10 for business or home use.

If you work in the IT industry, I suspect you will have heard the adage "if it ain't broke, don't fix it" more than once in your career. While it sometimes holds true, it fails when things start gathering a layer of dust. By this time, you have little or no idea how to fix things when they go wrong.

Windows 10 going out of support is a big deal, if only because there's a lot of perfectly usable hardware out there that can't be moved to Windows 11. And while this might seem "skipware", it raises the question of what to do.

The answer is actually simple if there is no update path: either cough up the money for extended support or change your hardware. It really is that straightforward.

For the home user, the extended paid-for support is available for just one year, and although it will put off the replacement day, it doesn't really do so in a meaningful way. It's time to get new hardware that runs Windows 11 and transfer everything across. You can either keep the old box disconnected from the network and running Windows 10, or move to a modern Windows-alike Linux. Mint is my preferred choice.

If you want to retarget the computer to Linux, then use the facilities to create a boot USB drive for the Linux Mint installation. Then try it! You'll soon know if it works well on your hardware and can decide whether you get on with it well enough for a permanent move. Once this has been done, the tools are supplied to steal away disk partition space from the Windows installation, and to create a dual boot environment. This will allow you to boot back and forth between Windows and Linux Mint as you transition from one to the other.

Moving your world across is never going to be easy, and I confess I prefer a "clean start" approach. Making sure you have backups in place, and copies of all critical data, is the key point. Cloud services such as Gmail, Hotmail, OneDrive and Dropbox are all extremely helpful in this context.

This is also the perfect time to take a long, hard look at how your data is stored. Are you relying on this one Windows 10 computer, and is there an existing workable disaster recovery plan in place for it? And do you know that this will work? In many home use cases, I suspect this isn't the case, and there's an almost endless supply of hope and finger-crossing involved. If you aren't using cloud services such as Dropbox, now is the time to start thinking about it.

For businesses, Microsoft is offering three years of support on a rising price plan. Tread carefully. This should only be used in the most extreme cases: you might have some industrial control software that only runs on Windows 10, and for which the developer hasn't moved to Windows 11 support. This rings all sorts of alarm bells for continuity and risk planning in the business, and while you could move to running the mission-critical app in a locked-down Windows 10 virtual machine running on Windows 11, this is going to be a mess.

ABOVE If you have old hardware that won't run Windows 11, now is the time to upgrade.

If you have a mission-critical app that won't run on Windows 11, then the same rules apply but those sirens are now wailing loudly. You have six months to sort this out before opening the cheque book in the hope of delaying the inevitable.

Look carefully at your estate of hardware. How ageing is it that it won't run Windows 11? Can you swap out the computer component and reuse the screen, mouse and keyboard? If so, the new Windows terminal box from Microsoft – the Windows 365 Link, which we cover on the following page – might be just the ticket if you're prepared to make the leap into cloud-hosted Windows sessions.

Yes, it comes at a high cost. But please trust me on this – so does running an old estate of PCs with all the insecurities and unpredictable failures that will become so tiresomely frequent.

WINDOWS 11

If the end of support for Windows 10 is prompting you to buy new hardware and you're staying within the Windows ecosystem, you're going to end up with Windows 11 in one form or another. But the choice here isn't as simple as it once was.

There's now a debate to be had over "sticking" with the x86 version of Windows 11 or plumping for Windows on Arm. Within those two camps, there's a choice to be made between Home and Pro versions, at least for consumers. And you might even be thinking about running Windows 11 from the cloud (see box on Windows 365, opposite). Let's start breaking down the decision-making process.

x86 or ARM?

A year ago, Windows on Arm was looking like the version of Windows with a few too many compromises. Now, it's a much harder choice – assuming you're thinking of buying a laptop rather than a desktop that is.

Windows on Arm has yet to make any significant inroads on the desktop, bar a couple of developer systems. In the fullness of time, it might arrive on mini PCs or all-in-ones, but for now it's largely confined to laptops.

The biggest advantage of the Arm architecture is power efficiency. The A-Listed Lenovo ThinkPad T14s Gen6 (Snapdragon) lasted almost a full day in the PCMark Application benchmark, which runs a mix of Office and web- based apps. That's not a full working day, that's a full day – 23hrs 39mins of constant usage. And though we've seen recent Intel processors making great strides in power efficiency, they're unable to reach those heights.

The 12-core Qualcomm Snapdragon X1E-78-100 system-on-a-chip inside the ThinkPad isn't light on muscle, either. It matched Intel's Core Ultra 7 in the Geekbench 6 single-core test, and hammered it in the multicore section, although Intel had the slight edge in Cinebench 2024. Certainly, for everyday work apps, there's no need to fear running Windows on Arm.

That's partly because app compatibility has grown much healthier. It's a stat that might have fallen victim to Stockholm Syndrome, but Microsoft claims that aggregated app usage data from Copilot+ PCs in several countries showed that owners were spending more than 90% of their time in apps coded specifically for the Arm platform. That list includes the full Office suite, Dropbox, Slack, most of Adobe's Creative Suite, Spotify, Netflix, Visual Studio Code and almost all of the well-known web browsers. Even those apps that aren't yet native will likely run fine with the Prism x86 emulation software.

ABOVE Lenovo's Arm-based ThinkPad T14s Gen6 offers stunning battery life.

"Windows 11 on Arm has significantly matured, with improved software compatibility, including native ARM64 apps (eg, Microsoft Office, Google Drive), and better x86/x64 emulation," said Kashif Nazir, technical manager at Cloudhouse, a company focusing on application compatibility and cloud enablement. "Arm-based devices offer exceptional portability, battery life and cloud-first integration, making them ideal for mobile workforces, lightweight business tasks or cloud-reliant environments. However, businesses relying on specialised or legacy software should verify compatibility before migrating."

Gaming is the one major area where the Intel/AMD axis still has a big advantage. That's largely because few games run natively on Arm, forcing them into the frame-rate-sapping emulator. Nor will you find an Arm-based Windows laptop with dedicated graphics chips, instead relying on Qualcomm's integrated Adreno GPUs. If gaming is even part of the reason for buying a new laptop, it's better to stick with the x86 machines.

Sticking to x86 doesn't necessarily mean huge compromises on battery life, either. As we mentioned, Intel has been working hard to match the renowned Arm power efficiency, and the Intel-based Asus Zenbook S14 lasted for just over 19 hours in the light-use battery test. That uses one of Intel's new Core Ultra 200V processors, which are geared towards efficiency rather than out-and-out performance, but it's hopefully indicative of a new era of all-day battery life in x86 laptops that aren't being thrashed with games or other high-intensity tasks.

Pro or Home?

If you're buying a new PC or upgrading from Windows 10, it's worth a quick recap of the differences between the Home and Pro versions of Windows 11. Both the x86 and the Arm-based versions of the OS support Home and Pro editions, so the information below applies equally to both.

Obviously, if you're buying for a business, then Pro is the only realistic choice. You might not be too bothered about technically breaching Microsoft's licensing terms by using a Home licence for business, and the chances of you being caught are minimal, but there are several business-specific features that are excluded from the Home version. For example, Home machines can't join a domain, support Group Policy or be managed with Windows Intune.

It's really only small businesses or sole traders who would even consider buying a Home licence over Pro anyway, but even at this level, where you might not have any central IT management, there are reasons to stick with Pro. BitLocker device encryption is one big absentee from Windows Home, meaning that if you were to leave a work laptop on a train or have it stolen in a burglary, your data should be protected.

Virtualisation is another Pro-only feature. If you want to keep old apps running in a virtual OS or maybe run a Linux coding environment, you can do so with Hyper-V. Third-party virtualisation software such as VirtualBox does run on the Home edition, but it's much simpler to use the native Hyper-V in most scenarios. Windows Sandbox, which allows you to test untrusted software in a separate instance from your main desktop, is another feature that you won't find in the Home edition.

If you think you're going to need Pro, it's normally cheapest to have it installed at the point of purchase. You can upgrade in place from Home to Pro in Windows 11, but it's a punch at $99 if you go through the Microsoft Store. You can find licences cheaper online, but these aren't always legitimate.

Once you have your activation key, go to Settings | System | Activation and change the product key manually. The features are already installed with the OS; applying the activation key just unlocks them. All of your data and apps should remain untouched.

ABOVE The Windows 365 Link is Microsoft's take on the mini PC.

Arm-based devices offer exceptional portability, battery life and cloud-first integration

WINDOWS 365

If the cost of rolling out new hardware is one reason businesses are stalling on Windows 10, Windows 365 provides a potential solution.

Now an established part of the Microsoft lineup, Windows 365 is a virtual Windows instance hosted in the cloud, accessible from a range of internet-connected devices, including other Windows desktops, iOS or Android devices. Windows 365 subscribers can currently choose between Windows 11 and Windows 10 as their cloud operating system, although presumably Microsoft will phase out Windows 10 as an option when it reaches end-of-life.

While Windows 365 may spare you the upfront cost of new hardware, the long-term costs need to be considered carefully, particularly if you need one of the punchier specs. The Basic plan costs only $58 per user per month, but for that you only get two virtual (and unspecified) vCPUs, 4GB of RAM and 128GB of storage. At the other end of the scale, the Premium version delivers four vCPUs, 16GB of RAM and still only 128GB for a much fruitier $76.70 per month. That's a $920+ a year investment for not a lot of PC.

There are business benefits to Windows 365 compared to running your own hardware. There's reduced energy costs, no direct hardware support costs, and Microsoft takes care of the security provision. For staff working from home, you can let them remotely access their work desktop from their personal devices, without worrying about any security compromises. And for businesses that are hotdesking or employing a lot of temporary/short-contract staff, it could prove more cost-effective than kitting out offices with new PCs, although staff will still need some form of hardware to access the service from.

That device could even be a (whisper it) thin client from Microsoft itself. The company recently announced the Windows 365 Link – a mini PC similar in stature to the Mac mini – which is a client designed to exclusively access Windows 365. It's small, fanless and wakes "instantly" from sleep. David Weston, vice-president of enterprise and OS security at Microsoft, told The Verge that the way to think of it was as a "super hardened" version of Windows. "Everything that runs is signed by Microsoft and it's isolated in sandboxes," he added, comparing it to something like the Xbox in terms of its closed nature.

The Link can support multiple displays, and has two USB-A 3.2 ports and a single USB-C 3.2 port, as well as DisplayPort and HDMI outputs. It has both Ethernet and Wi-Fi 6E connectivity, as well as Bluetooth 5.3 for connecting wireless peripherals. It will go on sale in April, but while we know it will cost $349 in the US, Microsoft hasn't yet confirmed its Australian price. If you're in a rush, Dell and Lenovo offer similar thin client devices. Yet even on the most Basic plan, you're still looking at a year-one cost in the region of $696 for a Windows 365 Link device. Wes Miller isn't sure that is likely to lure many businesses – and it remains business-only for now – that have yet to make the move to Windows 11.

"I don't think a customer who has held out on migrating to 11 to this point is likely a good candidate to pay the premium price for Link, as well as the premium price for Windows 365," he said. "Some may move that way, but it will be a small minority of customers."

	Basic	Standard	Premium
Price per month	$58	$76.70	$123.50
vCPUs	2	2	4
RAM	4GB	8GB	16GB
Storage	128GB	128GB	128GB
Users	Up to 300	Up to 300	Up to 300

WINDOWS 12?

Another reason to add to the growing list of excuses of why people are sticking with Windows 10 is the uncertainty of what's happening with Windows 12 – or whatever the next major version might be called.

The cadence of Microsoft's Windows version releases has become entirely unpredictable. Windows 7 was released in 2009, Windows 8 followed in 2012, and Windows 10 in 2015, but that seemingly ended the three-to-four year gap between major versions. Windows 11 was something of a shock drop in 2021, because although it had been six years since the previous release, Microsoft had previously suggested it wasn't planning a major new version, but would instead keep providing cyclical updates for Windows 10. Now nobody is quite sure when or whether Windows 12 will make an appearance.

An obvious opportunity for a major release has seemingly passed. The flurry of AI features added to Windows 11 in the past couple of years, not least the controversial Recall feature, would have given Windows 12 a clear point of differentiation from Windows 11. Instead, Microsoft opted to go down the Copilot+ PC route, making some of those features available exclusively to PCs that meet certain NPU requirements.

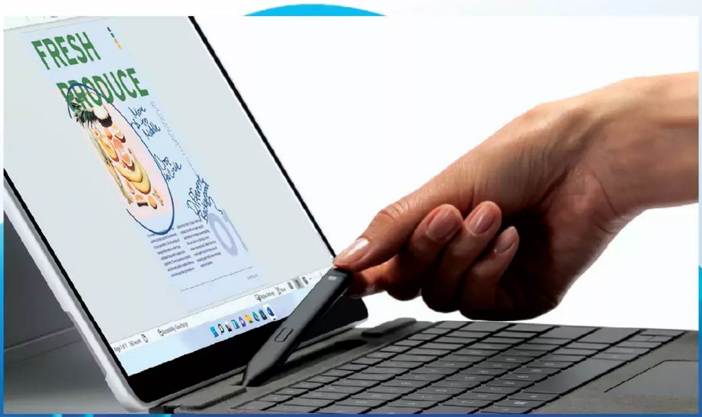
A very underwhelming set of new features for the annual Windows 11 24H2 release maybe hints that Microsoft is saving standout new features for Windows 12, perhaps for announcement in 2025. But if Microsoft does announce a new OS, it will give those on Windows 10 an even greater incentive to hold fire on upgrades until Windows 12 machines are on the market, which won't be until the back end of the year at the very earliest, pushing them past the October cut-off date.

Copilot
A whole new way to work

ABOVE Microsoft has made much of Copilot+, making features available only to those PCs that meet certain requirements.

"Much has been made of a potential [Windows] 12, but if Microsoft is having this much difficulty getting organisations off 10 to 11, in this economy I have a hard time believing a shift to 12 or any other brand will do anything to speed the shift, clear out stragglers, etc," said Wes Miller from Directions on Microsoft. "It honestly just becomes a marketing pushpin to try and generate excitement. But I don't think that matters for business customers."

BELOW Judging from Surface devices, Windows 12 might require a touchscreen.



Nobody is quite sure when or whether Windows 12 will make an appearance

The Apple option

If nobody's quite sure when the next version of Windows will arrive, you can be more certain about the cadence of macOS. Although the annual new versions of macOS are arguably comparable to Windows' annual updates, they have been as regular as clockwork for over a decade and don't pull up the ladder on old Mac hardware that aggressively.

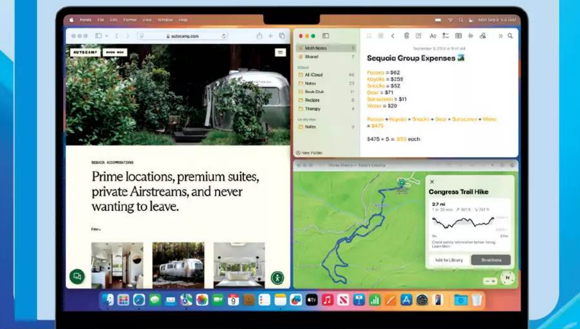
That said, with next year marking five years since Apple launched its own M1 silicon, it's possible that macOS 16 will cease support for Intel-based processors. That would be a significant milestone, and one that underlines how Apple has mastered the shift to Arm-based silicon at a much faster lick than Microsoft has. This despite Microsoft releasing the Arm-based Surface RT back in 2012, eight years before Apple bet the house on Arm architecture.

Even though the Arm-based Windows machines have delivered big improvements in performance and battery life in recent months, Kashif Nazir from Cloudhouse believes that Apple is still the pacesetter. "Apple's long-standing dominance in Arm computing through its Apple silicon (M1, M2, and beyond) highlights the potential of the Arm architecture," he said.

"By combining vertical integration (hardware and software co-design) with unmatched performance and efficiency, Apple has set a benchmark that Arm-based Windows devices are working to match. While Windows on Arm has made significant strides, particularly in power efficiency and portability, it still trails Apple's ecosystem in terms of performance optimisation and software ecosystem maturity."

For businesses, switching platforms comes with all manner of other considerations – including staff training, device management and software compatibility – that all have to be carefully weighed up before even thinking about jumping horses. For consumers, the hurdles are less onerous. It's arguably never been easier to switch between Windows and Mac (and vice versa), what with cloud services and the huge cross-compatibility of major applications.

Gaming remains the Mac's biggest blackspot, with Apple's own GPUs failing to match the performance of dedicated Nvidia/AMD GPUs, and game availability still very restricted. Nevertheless, cloud gaming services such as Nvidia's GeForce Now can bridge the divide – albeit at a significant price.


Prime locations, premium suites, private Airstreams, and never wanting to leave.
Sequoia Group Expenses
Congress Trail Hike

australian
hi-fi
Show SYDNEY 2025

BROUGHT TO YOU BY
australian hi-fi
SOUND IMAGE
WHAT HI-FI?
Scan to buy tickets online ▶

SHOW TIME!
4-6 APRIL 2025
AT THE SYDNEY CENTRAL HOTEL
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Celebrating the latest and greatest in the hi-fi and AV industry, giving visitors the opportunity to see and hear a range of products from all around the world, featuring live demonstrations of some of the world's most renowned hi-fi and AV brands including high-end audio, TVs, projectors, headphones, home theatre systems, amplifiers, streamers, wireless and Bluetooth speakers and everything in between.

2024 SHOW IMPRESSIONS

McIntosh
Sonus faber
in every detail.
YAMAHA

THE ULTIMATE WINDOWS 11 INSTALL GUIDE

APC veteran **Zak Storey** on how to reinstall our favourite OS.

Ah, Windows 11, you old devil. Microsoft's latest iteration of its operating system line might be quite contentious these days, filled with advertising, data scraping, and enough bugs to make even a Tyranid Hive Fleet jealous, but it's nothing if not a consistent thread throughout our custom PC building life.

It represents the ultimate middle-ground OS – versatile and customisable enough to outpace the very best of MacOS, yet with more than enough compatibility and stability to give any Linux distro a run for its money. If you just want to get an install up and running quickly, tailored just how you like it, and compatible with 99.9 percent of all the programs out there, then Windows is the place to be.

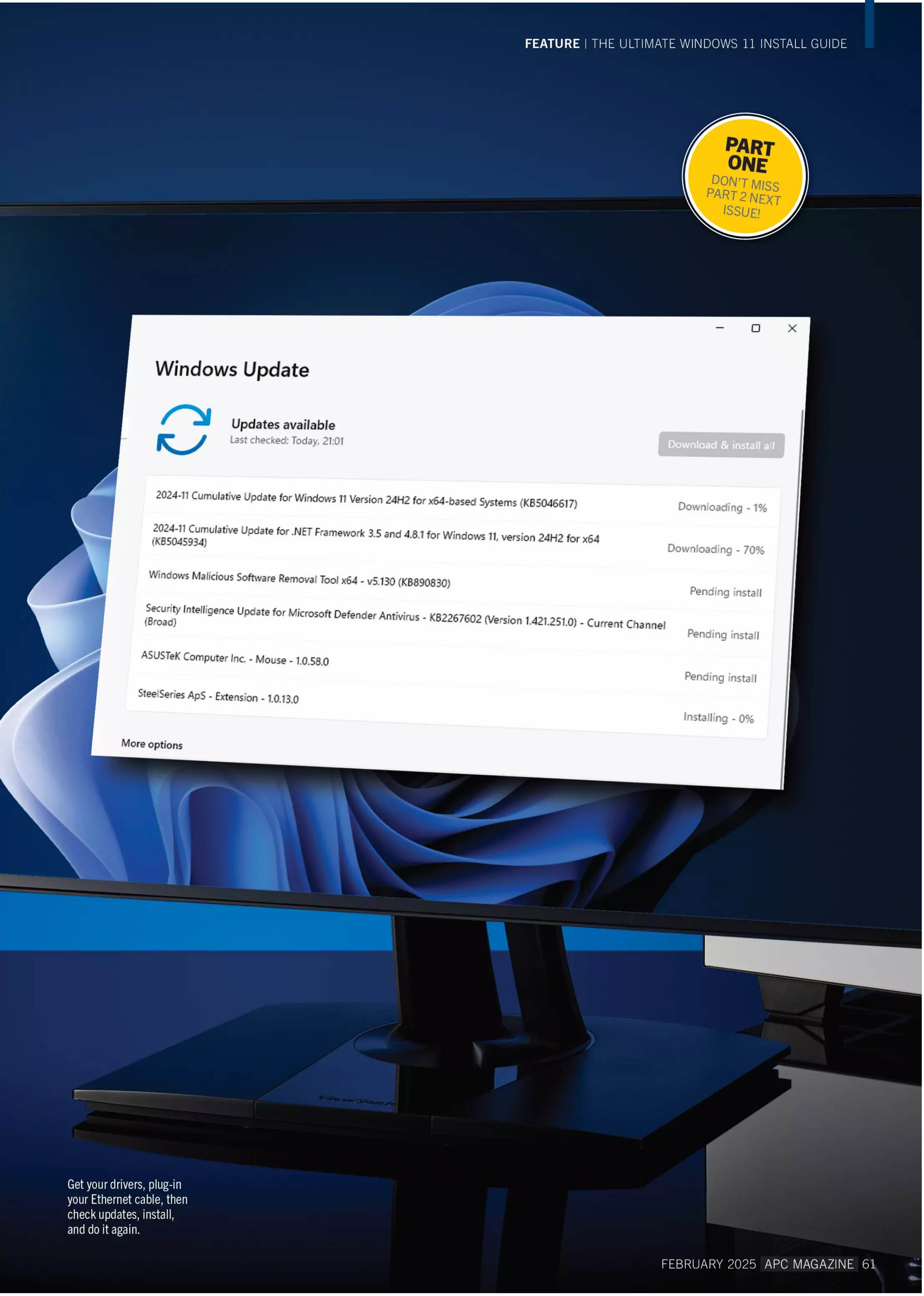
That said, it's not without its pitfalls. In our anecdotal experience, we often find that Windows OS seems to degrade over time. Performance falters, registry keys become corrupt, driver updates fail, and unnecessary background processes and programs hog up the resources that should otherwise be elsewhere. It's almost become a *APC* tenet, but seriously, if you're not already, you should consider reinstalling your Windows OS every three to six months. It's on the same level as 'it's probably memory' and 'have you tried turning it off and on again' in our most repeated PC troubleshooting phrases.

Not only will you get a clean install, it'll also give you the opportunity to throw out any old programs and keep everything running nice and smoothly in the meantime.

There are also a lot of customization tweaks you can do with the modern form of Windows. As always, your own install will inevitably be unique to you, designed for your needs, but today we're going to share with you just how we here at *APC* install Windows on everything from our personal machines to test systems and beyond. We'll cover our general install process, what tweaks we perform, how we configure it to maximise its utility, and tips on how to streamline its efficiency, leaving you with an ultra-slick desktop that's perfect for anything you throw at it. Let's dive in, shall we?

PART ONE

DON'T MISS PART 2 NEXT ISSUE!



Windows Update

Updates available

Last checked: Today, 21:01

2024-11 Cumulative Update for Windows 11 Version 24H2 for x64-based Systems (KB5046617) Downloading - 1%

2024-11 Cumulative Update for .NET Framework 3.5 and 4.8.1 for Windows 11, version 24H2 for x64 (KB5045934) Downloading - 70%

Windows Malicious Software Removal Tool x64 - v5.130 (KB890830) Pending install

Security Intelligence Update for Microsoft Defender Antivirus - KB2267602 (Version 1.421.251.0) - Current Channel (Broad) Pending install

ASUSTeK Computer Inc. - Mouse - 1.0.58.0 Pending install

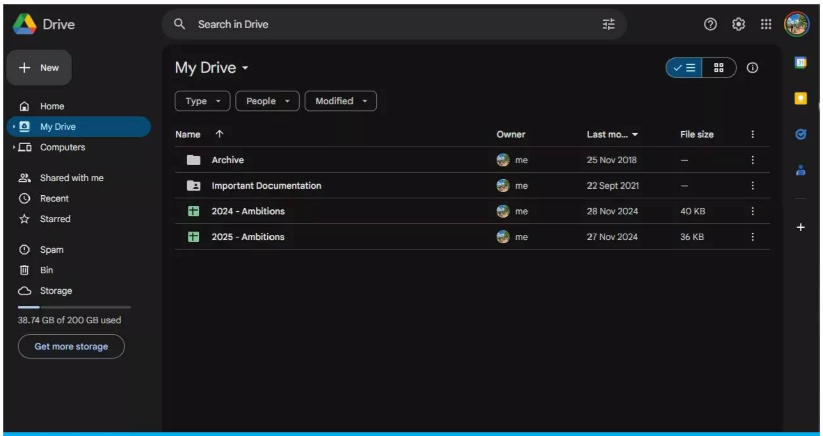
SteelSeries ApS - Extension - 1.0.13.0 Installing - 0%

Get your drivers, plug-in your Ethernet cable, then check updates, install, and do it again.

THE PREPERATION STAGE

WHERE DO YOU EVEN START WITH A TASK LIKE THIS?

Okay, we understand – a big reinstall can be pretty daunting on first glance. You're effectively going to wipe your operating system drive and start from scratch. That means every file, program, and document is going to be effectively erased from existence and scattered into the unknown on your SSD, ready to be rewritten. With that in mind, there's a ton of prep work that you're going to want to do on your rig to make this a super-smooth process (you don't necessarily have to do this on your current PC; you can do it on a laptop or secondary device, but ideally you need a form of Windows running somewhere to get started).


Drive
Search in Drive
New
Home
My Drive
Computers
Shared with me
Recent
Starred
Spam
Bin
Storage
38.74 GB of 200 GB used
Get more storage
My Drive
Type
People
Modified

Name	Owner	Last mo...	File size
Archive	me	25 Nov 2018	—
Important Documentation	me	22 Sept 2021	—
2024 - Ambitions	me	28 Nov 2024	40 KB
2025 - Ambitions	me	27 Nov 2024	36 KB

Having a cloud backup takes a lot of the pressure off.

STEP 1

Backup and order

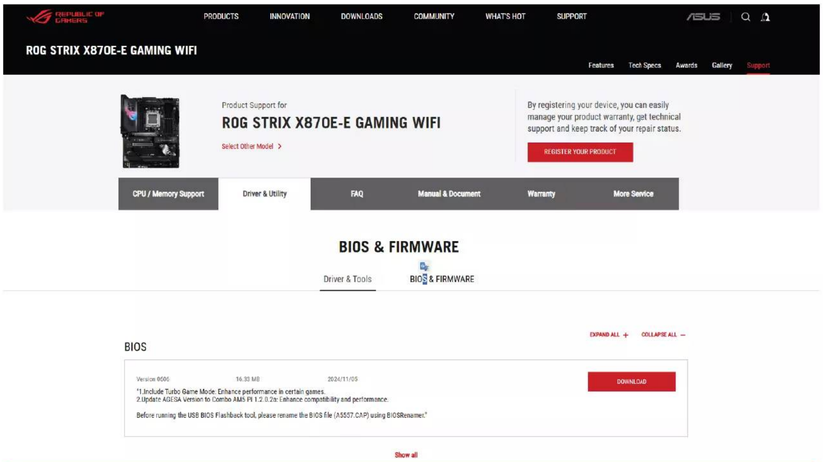
We're massive advocates of using a twin-drive system, no matter what your ambitions are. Having two SSDs or hard drives of some calibre to keep your most important files separate and safe is incredibly useful, and makes the whole reinstall process super quick and easy.

The first thing we're going to do in our build is ensure any files we currently have on our Windows system are backed up appropriately. In an ideal world, any large programs (we're mostly talking about games here) can be offloaded to a secondary drive. If it's not part of your installation process already, it should be. Installing *Elden Ring* or *World of Warcraft* onto a D: drive solely dedicated to games will save you a ton of time later, particularly if you don't have the fastest internet speeds.

Not only do we use our D: drive for our large programs; we're also going to use it for temporary storage for other documentation. Go into your documents, pictures, videos, and screenshots, grab whatever imperative files you need, and chuck them onto your secondary drive.

For anything more mission-critical to your well-being and day-to-day life, it's best to upload these to a well-secured cloud service. We're big advocates of Google Drive for that. If you have a Gmail or Google account already, then you'll likely have an unactivated Drive account just sitting there. Simply go to drive.google.com, and upload and organise your files; it's free up to 15GB, and if you need more space, it's fairly affordable, with options ranging from US$2 per month (100GB) up to US$25 per month (5TB). There's even a desktop-syncing program that acts similarly to Box or Microsoft's 365 cloud file system if you need it.

Things we typically back up include any Adobe files we've been working on, wallpapers, screengrabs, Elgato profiles and presets, and similar. For gaming, most save files are now stored in the cloud anyway, but it's always worth checking. A lot of this is going to be dependent on how you run your digital life – more on that in a bit.


REPUBLIC OF GAMERS
PRODUCTS
INNOVATION
DOWNLOADS
COMMUNITY
WHAT'S HOT
SUPPORT
ASUS
Features
Tech Specs
Awards
Gallery
Support
Select Other Model
REGISTER YOUR PRODUCT
CPU / Memory Support
Driver & Utility
FAQ
Manual & Document
Warranty
More Service
Driver & Tools
BIOS & FIRMWARE
EXPAND ALL +
COLLAPSE ALL –
DOWNLOAD
Show all

ROG STRIX X870E-E GAMING WIFI

Product Support for

ROG STRIX X870E-E GAMING WIFI

By registering your device, you can easily manage your product warranty, get technical support and keep track of your repair status.

BIOS & FIRMWARE

BIOS

Version 0606 16.33 MB 2024/11/05

"1.Include Turbo Game Mode: Enhance performance in certain games.
2.Update AGESA Version to Combo AM5 PI 1.2.0.2a: Enhance compatibility and performance.

Before running the USB BIOS Flashback tool, please rename the BIOS file (A5557.CAP) using BIOSRenamer."

Always download chipset/BIOS updates direct from the motherboard's product page.

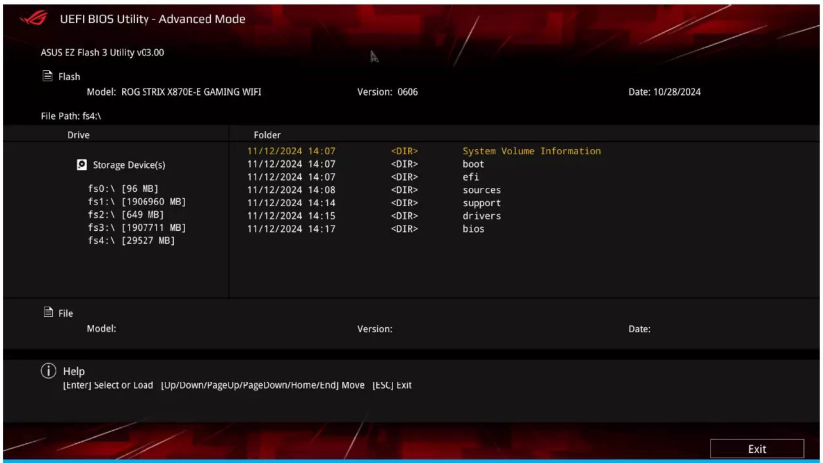
STEP 2

USB installer and setup

Now we've done that, it's time to grab a decent USB flash drive of some description – the faster the better. Ideally, if you can, get a cheap USB Type A 3.2 drive off Amazon – your install and file transfer process will go a lot faster. SanDisk sells a three-pack of 32GB 3.2 Type A drives for just $22 on Amazon; having them lying around your office can be helpful in a pinch.

With your drive plugged in and installed, take any files or programs off it, then head to Google and search 'Download Windows 11'. Click the top link, then select the second 'Download Now' button under 'Create Windows 11 Installation Media'.

Run the program, accept the terms and conditions, select the version of Windows



```
ASUS EZ Flash 3 Utility v03.00

Flash
      Model:  ROG STRIX X870E-E GAMING WIFI        Version:  0606                Date: 10/28/2024

File Path: fs4:\
        Drive                   Folder
                                11/12/2024 14:07        <DIR>       System Volume Information
        Storage Device(s)       11/12/2024 14:07        <DIR>       boot
                                11/12/2024 14:07        <DIR>       efi
          fs0:\ [96 MB]         11/12/2024 14:08        <DIR>       sources
          fs1:\ [1906960 MB]    11/12/2024 14:14        <DIR>       support
          fs2:\ [649 MB]        11/12/2024 14:15        <DIR>       drivers
          fs3:\ [1907711 MB]    11/12/2024 14:17        <DIR>       bios
          fs4:\ [29527 MB]

File
      Model:                                       Version:                      Date:

Help
[Enter] Select or Load   [Up/Down/PageUp/PageDown/Home/End] Move   [ESC] Exit
```

Updating your BIOS in 2025 is not as daunting as it once was, but there's still a risk.

you want to install, then choose the flash drive you've plugged in, and the program will do the rest, creating a nice, bootable USB loader for you.

While that's doing its thing, we're going to grab some necessary downloads. We want a completely clean install, without any wanton Windows Updates or messy drivers, so we're going to download those first and chuck them on the USB stick.

Head to your motherboard's product page (in our case, that's the X870E-E Gaming WiFi). Click support, then make your way to downloads, or Driver & Utility. You will want to download the following:

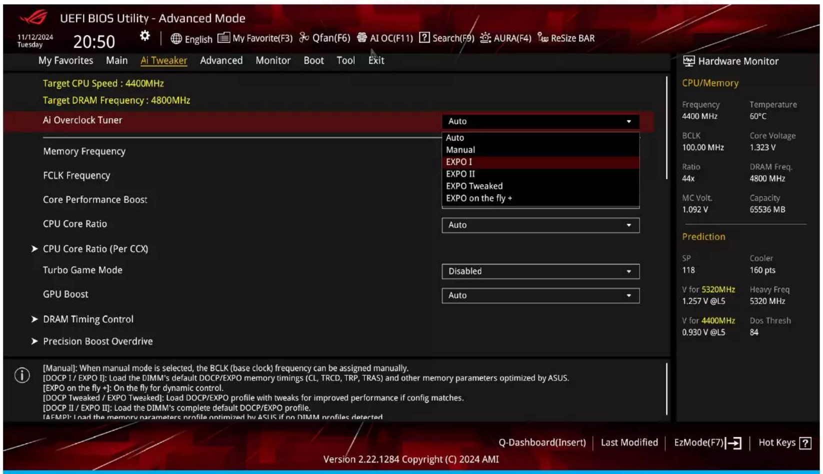
- Lan Driver
- Chipset/NPU/ME Drivers
- Audio Driver (usually Realtek)
- Bluetooth Driver
- WiFi Drivers
- Latest BIOS file

Motherboard manufacturers aren't the best at labeling and organising these things on the sites, so make sure you pick the latest version you can for each. Usually, there'll be a numerical version indicator or a date for you to go off.

At this point, it's also worth picking up any Nvidia or AMD GPU drivers you'll need. Google 'GeForce Drivers', head to the Nvidia page, select the version of Windows and your GPU, and download the latest version. For AMD, search for your GPU product name and drivers, and again download the latest Adrenalin Edition.

By this point, Windows should have finished with your USB stick. Open File Explorer and click 'This PC'. In the drives section, you should see 'ESD-USB'. This is your Windows 11 installer drive. Double-click the drive and create two new folders: one called 'bios', and one called 'drivers'.

With that, place your zipped drivers into the drivers folder and your BIOS into



```
Target CPU Speed : 4400MHz
Target DRAM Frequency : 4800MHz
Ai Overclock Tuner                      Auto
                                        Auto
Memory Frequency                        Manual
                                        EXPO I
FCLK Frequency                          EXPO II
                                        EXPO Tweaked
Core Performance Boost                  EXPO on the fly +
CPU Core Ratio                          Auto
> CPU Core Ratio (Per CCX)
Turbo Game Mode                         Disabled
GPU Boost                               Auto
> DRAM Timing Control
> Precision Boost Overdrive

[Manual]: When manual mode is selected, the BCLK (base clock) frequency can be assigned manually.
[DOCP I / EXPO I]: Load the DIMM's default DOCP/EXPO memory timings (CL, TRCD, TRP, TRAS) and other memory parameters optimized by ASUS.
[EXPO on the fly +]: On the fly for dynamic control.
[DOCP Tweaked / EXPO Tweaked]: Load DOCP/EXPO profile with tweaks for improved performance if config matches.
[DOCP II / EXPO II]: Load the DIMM's complete default DOCP/EXPO profile.
[AEMP]: Load the memory parameters profile optimized by ASUS if no DIMM profiles detected.

CPU/Memory
Frequency        Temperature
4400 MHz         60°C
BCLK             Core Voltage
100.00 MHz       1.323 V
Ratio            DRAM Freq.
44x              4800 MHz
MC Volt.         Capacity
1.092 V          65536 MB

Prediction
SP               Cooler
118              160 pts
V for 5320MHz    Heavy Freq
1.257 V @L5      5320 MHz
V for 4400MHz    Dos Thresh
0.930 V @L5      84

Version 2.22.1284 Copyright (C) 2024 AMI
```

Make sure you've enabled XMP, EXPO, or DOCP to take advantage of your memory speeds.

MINIMALIST LIVING

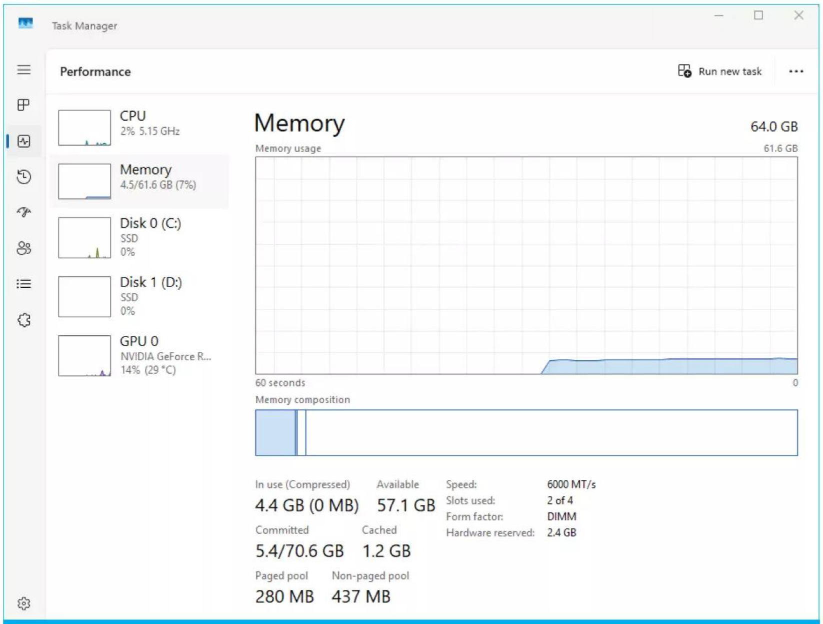
Reinstalling Windows so belligerently might sound blasphemous for some, but for others, it's part of their digital routine, planned down to a date. But how can that be the case? Why is it so easy for some and not others? Well, it all comes down to how you manage your files and programs.

We're proponents of file and program minimalism. It's a simple concept, and takes a lot of ideals from minimal living as a whole. Look at your system, the programs you use, and the files you keep, and try to minimise what you store locally or house on your C: drive.

For instance, financial and legal documentation, planning documents, databases, copies of birth certificates – all of these can be held in the cloud, out of harm's way. Choose a provider that you can trust, and upload a copy to a well-secured place with strong password protection and multiple forms of two-factor authentication behind it. More importantly, keep a physical copy, too, if you don't already.

A pretty neat program and file storage mantra we keep in mind is this one question: "How often do I use this?" If the answer is less than once a month, then it shouldn't be stored locally on your machine. Alternatively, it can be deleted. You can use a secondary statement as a fail-safe, too: 'Is it mission critical if I don't have this program right now?' just to be sure. But by doing this, it'll help you eliminate a lot of the clutter from your rig, allow you to run with less clutter and background programs, and even minimise how much storage you need.

It's an effective way of looking at all of your belongings, digitally or otherwise, if we're honest. How often do you use X or enjoy Y? If the answer is very little, then perhaps it should be stored for later use. It's an idea and concept we take into designing user interfaces, databases, documents, workflows, etc. How can you streamline and make things more efficient without sacrificing comfort and enjoyment?



CPU 2% 5.15 GHz

Memory 4.5/61.6 GB (7%)

Disk 0 (C:) SSD 0%

Disk 1 (D:) SSD 0%

GPU 0 NVIDIA GeForce R... 14% (29 °C)

Memory 64.0 GB

Memory usage 61.6 GB

In use (Compressed) 4.4 GB (0 MB)
Available 57.1 GB
Committed 5.4/70.6 GB
Cached 1.2 GB
Paged pool 280 MB
Non-paged pool 437 MB
Speed: 6000 MT/s
Slots used: 2 of 4
Form factor: DIMM
Hardware reserved: 2.4 GB

Task Manager has a ton of helpful system-monitoring stuff built in these days.

the bios folder. Make sure the BIOS file is extracted and renamed if necessary (you'll know, because the manufacturer will have a renaming batch file with it, and it'll state in the readme on the download).

Now, it's time to say one last goodbye to this install of Windows, and fully commit.

STEP 3 Rig-marole

If you're just reinstalling, this is going to be a super-easy procedure, as most of your peripherals are already connected. We're going to ensure that the USB stick is situated in the back of the motherboard I/O, and that any hard-wired Ethernet cables are disconnected. That's about it.

Chuck the USB stick into the fastest port you have on the back. Some motherboards do have a specific 'BIOS' USB port, but this is predominantly for if it supports BIOS flashback without a CPU.

We're keeping the internet out of this for the time being, as Microsoft has a bad habit of installing updates early on in the process, before you can even login to Windows, and that includes graphics drivers and chipsets that we want to avoid for the time being.

With that done, power on your machine, and mash that delete key in order to get into the BIOS. Once you're in, you're going to want to get the BIOS into its 'advanced mode' (usually the F7 key), then head to Tools. Here, you should be able to find a BIOS Flashback or EZ BIOS Update tool. Go into there, then find your USB stick, and select the BIOS file. Let the updater install the update. It's imperative that you do not turn off or lose power to the machine during this process. Your PC will restart a few times during the update as well – be aware that it can take some time to fully complete. Once done, you'll find yourself back on the initialisation screen, with BIOS settings reset, and the PC asking you to configure them.

Head into BIOS, and make sure that you're now on the updated BIOS version before enabling XMP or EXPO for your memory. Then, head to your boot/load order section and ensure the USB stick is first in the list. It's also a good opportunity to configure any fan control speeds while you're here. With that done, hit F10, save, and exit, and your machine should restart and load into the Windows installer.

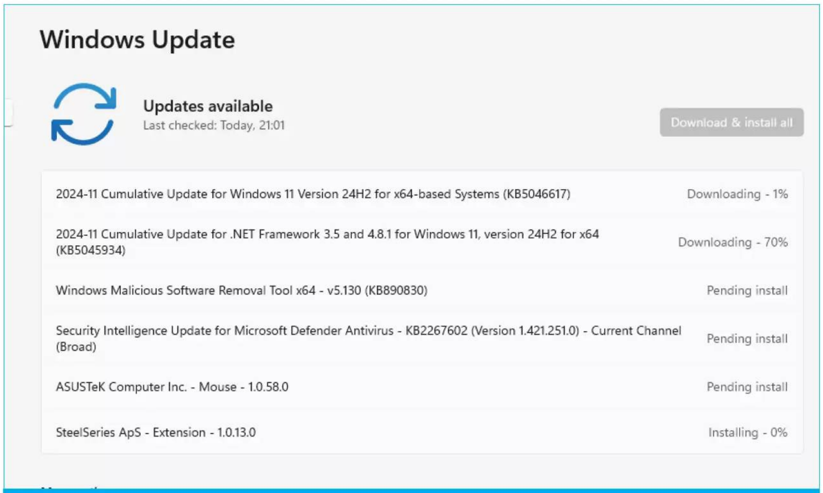
STEP 4 Windows install hoops

Now that you're on the install page, we're going to do this the old-fashioned way, as it gives us better visibility. On the bottom of the first page on the installer, there'll be a line of text that lets you use the old installer. We're going to use that for this guide.

With that done, go through the prompts until you reach the drive selection segment. Now, you're going to want to identify the drive that houses your OS. This should already be partitioned into three separate segments: a 100MB segment, a 650MB recovery segment, and the main drive. Your D: drive should be a singular segment. Now, you're going to delete those three segments on the OS SSD until you're left with 'unallocated', roughly the same size as the drive's total capacity. Don't worry about formatting them – you don't need to these days, as the drive will write over whatever was stored on there.

Select the 'unallocated' storage and hit next. Windows will then proceed to install itself onto here, once again splitting it into three segments for your OS. Once it's finished, your system will restart and lead you to the official install setup process.

When you're on the page that asks what keyboard setup you have, skip through these settings quickly until Windows asks you to connect to a network. We're not



Updates available
Last checked: Today, 21:01

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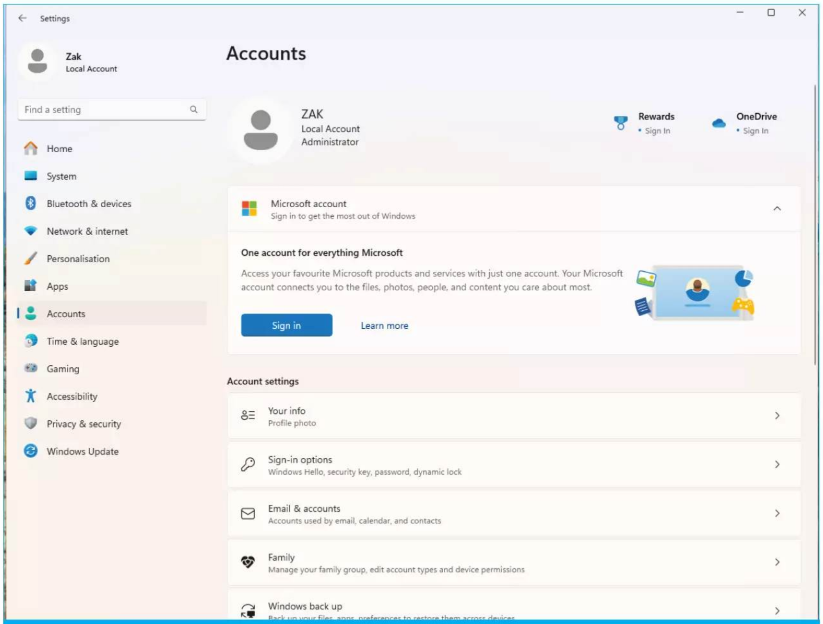
ASUSTeK Computer Inc. - Mouse - 1.0.58.0 Pending install

SteelSeries ApS - Extension - 1.0.13.0 Installing - 0%

Get your drivers in, plug in ethernet, then check updates, install, and do it again.

going to do that. Instead, hit Shift-F10 to open command prompt. Then, with command prompt selected (you might need to click it with the mouse), type "OOBE\BYPASSNRO" without the speech marks, and hit enter (that's a back slash there, not a forward slash). The installer will restart and bring you right back to the select keyboard page. This time, select the options you want. Once you hit the 'connect to the internet' page again, this time on the bottom right, there should be a small line of text saying, 'I can't connect to the internet right now'. You'll then be able to create a local account. Name your account, set a password, and proceed to go through the motions. You can say no to practically everything; however, we'd recommend enabling location data.

Once that's complete, you'll land on a squeaky-clean desktop with no internet. Don't plug the cable in just yet.


Settings
Zak
Local Account
Find a setting
Home
System
Bluetooth & devices
Network & internet
Personalisation
Apps
Accounts
Time & language
Gaming
Accessibility
Privacy & security
Windows Update
Accounts
ZAK
Local Account
Administrator
Rewards
• Sign In
OneDrive
• Sign In
Microsoft account
Sign in to get the most out of Windows
One account for everything Microsoft

Access your favourite Microsoft products and services with just one account. Your Microsoft account connects you to the files, photos, people, and content you care about most.

Sign in
Learn more
Account settings
Your info
Profile photo
Sign-in options
Windows Hello, security key, password, dynamic lock
Email & accounts
Accounts used by email, calendar, and contacts
Family
Manage your family group, edit account types and device permissions
Windows back up

A Microsoft account is needed for the reinstall process.

STEP 5

Initial desktop setup

Now we've landed on desktop, we need to start installing our drivers. Before that, we're going to do a quick RAM check, hit Ctrl-Alt-Delete, and select Task Manager. Then, head to the 'Performance' tab on the left-hand column, and select the 'Memory' section. In the bottom right, it should be able to tell you the speed it's running at; if you're running at the same speed as your memory profile (which you should be), you're golden.

Next, we'll install those drivers. Head to your USB stick in File Explorer, and copy and paste all the drivers onto your desktop (or cut, if you're brave). You then want to extract each and find the 'setup' executable in each folder, and run through the install process. We recommend you do this in this order, one at a time.

1. CPU Chipsets & Related Drivers
2. Graphics Drivers
3. Audio
4. Bluetooth
5. Wi-Fi
6. Ethernet

You can now plug that Ethernet cable back in. Click the Start Menu, type 'Settings', go to 'Accounts', and hit the 'Sign In' button. Enter your Microsoft Account details, and create a PIN. If you've got a Windows 11 license tied to your account, this should activate Windows.

It's worth doing a quick restart after this. Once back on desktop, go back into Settings and find the 'Windows Update' tab. Click 'Check for updates', and download anything that might be missing. You might need to repeat this a few times to get everything on the system; some updates are dependent on others as well.

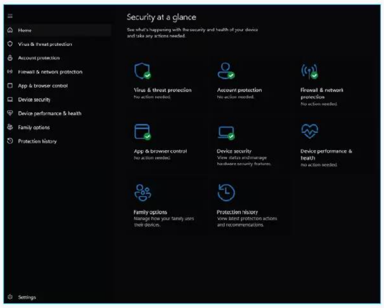
Now grab a cup of coffee, feel proud, and join us next issue for the final part of our guide. ■

THE BEST ANTIVIRUS

It's Windows Defender. It just is. No, honestly, the best defense you have against bad actors on the internet and other malicious code is good internet practices. Don't open attachments to random emails, click dodgy links, or download suspect programs, and you'll be golden. If the worst comes to the worst, you can just flatten your system and reinstall your OS.

Most aftermarket antivirus programs cause all manner of conflicts and issues on many of the PCs we've worked with over the years, sucking up valuable system resources, causing conflicts, and even outright stopping all manner of programs from running efficiently (even some of our benchmarking programs). We've seen them delete system files, parts of programs, and other benign applications on a whim, stop them from running, or crashing entire systems after Windows updates. The reality is that 99 percent of the time, they're just not worth running.

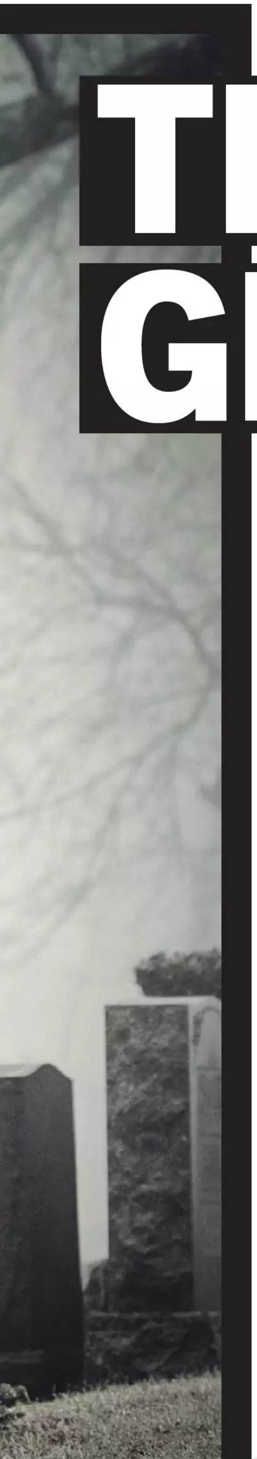
Sure, Malwarebytes is useful every now and then for a quick sweep, but Windows Defender is one of the most up-to-date, unobtrusive antivirus programs out there, and it's built into your operating system, doesn't take up valuable resources, and generally just works. You do not need aftermarket antivirus, so save yourself the subscription fee, and go grab a VPN instead.


Home
Virus & threat protection
Account protection
Firewall & network protection
App & browser control
Device security
Device performance & health
Family options
Protection history
Settings
Security at a glance

See what's happening with the security and health of your device and take any actions needed.

Virus & threat protection
No action needed.
Account protection
No action needed.
Firewall & network protection
No action needed.
App & browser control
No action needed.
Device security
View status and manage hardware security features.
Device performance & health
No action needed.
Family options
Manage how your family uses their devices.
Protection history
View latest protection actions and recommendations.

1928 2008
Beloved Husband ~ Father
1962 1987
Beloved Son



THE PC TECH GRAVEYARD

PC history has many dead ends, but buried in that graveyard is an enormous amount of innovation and potential. *John Knight* examines what we lost along the way, and see what lessons might be able to help predict the future. Let’s start with operating systems.

Microsoft XENIX

Although it’s largely forgotten now, there was a time when Microsoft was betting big on Unix, both in business and the home. As the retail computing world moved from 8 to 16-bit, Microsoft analysed the choice of operating systems, and expected Unix to eventually become the dominant platform.

Microsoft bought a license from AT&T in 1979, and announced its product for 16-bit microcomputers in August 1980.

Dubbed XENIX, the corporate giant had advertised their Unix variant as ‘the Microcomputer Operating System of the Future’. Instead of selling straight to customers, Microsoft used existing software vendors as middlemen, particularly The Santa Cruz Operation, or ‘SCO’, in which Microsoft bought a controlling share.

MICROSOFT
XENIX OPERATING SYSTEM
VERSION:1.00
10/15/84
INSTALLATION DISKETTE
(C) 1984 IBM CORPORATION
(C) 1984 MICROSOFT CORPORATION
MICROSOFT

Compared to MS-DOS, or even Windows well into the ’90s, XENIX was a behemoth. A review copy consisted of 19 floppy disks.

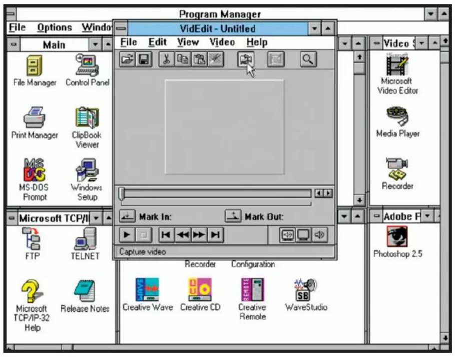
SCO had already been selling, porting, and consulting on Unix products, so it made sense to leave the difficult legwork to Santa Cruz.

On release, a complete SCO XENIX set cost $1,350, while a barebones system was $595. XENIX required at least a PC-XT with a hard disk and 256KB of RAM, although 512KB was recommended.

XENIX was a proper multi-user, multi-tasking operating system when DOS could only do one thing at a time, and any appearance of multi-tasking by Macs was smoke and mirrors.

Other users could access the system via the serial port, turning it into a ‘microframe’, and ten different people could switch between their own ‘virtual consoles’’ via a simple key combination – a feature still used today.

Although XENIX was targeted at multiple architectures, such as the Motorola 68000, Zilog Z8000, and PDP-11 server platform, it was really the IBM PC compatible where XENIX found its biggest user base.


Program Manager
File Options Windo
Main
VidEdit - Untitled
File Edit View Video Help
File Manager
Control Panel
Print Manager
ClipBook Viewer
MS-DOS Prompt
Windows Setup
Microsoft TCP/I
FTP
TELNET
Microsoft TCP/IP-32 Help
Release Notes
Mark In:
Mark Out:
Capture video
Recorder
Configuration
Creative Wave
Creative CD
Creative Remote
WaveStudio
Video
Microsoft Video Editor
Media Player
Recorder
Adobe P
Photoshop 2.5

The Windows 3.x series was far from perfect, but it was good enough for most people, and timing is everything.

When IBM released its new 286-based AT platform, XENIX really came into its own. This new off-the-shelf hardware standard allowed for much greater RAM and hard drive capacity, which was critical for running a good server.

For around $5,000, anyone could buy a top-spec AT with a big hard drive, making it an instant hit among universities and early ISPs, with XENIX being a natural fit for the task.

At the end of the decade, XENIX had become the most widely used version of Unix. However, as the PC platform moved to 32-bit, competition grew. Of particular note were Digital Research Inc's Unix System V (owned by AT&T), and IBM's own variant, PC/IX.

Microsoft didn't want to compete with such established corporate giants, and decided to end its involvement in Unix. Ownership of XENIX was transferred to SCO in 1987, although Microsoft retained its stake in the company.

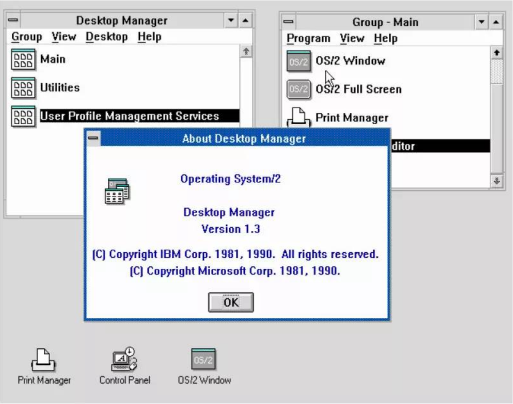
Uptake of Unix never really went beyond the corporate and scientific world, and the home user adoption Microsoft had predicted never happened – DOS was good enough for Joe Average. Microsoft entered into a short-lived alliance with IBM, working on OS/2, before focusing on their own NT architecture.

IBM OS/2

OS/2 was initially a joint project between IBM and Microsoft, intended to replace DOS. The naming scheme was based on IBM's second generation of PCs, the 'Personal System/2' (PS/2) line. IBM and Microsoft entered a joint development agreement in August 1985, before releasing OS/2 1.0 in December 1987.

OS/2 1.0 was only a text-based 'semi-GUI' affair, but had advanced features such as multi-tasking, a 'Protected Mode' for better stability, and an enhanced memory manager, allowing OS/2 to make use of the much greater RAM capacity available to 286 and 386 processors.

In October 1988, OS/2 1.1 was released. Its chief feature was a graphical desktop, which was extremely similar to Windows 2.0. This allowed multi-tasking to be done graphically, instead of using the text-based Program Selector of 1.0.



About Desktop Manager

Operating System/2

Desktop Manager
Version 1.3

(C) Copyright IBM Corp. 1981, 1990. All rights reserved.
(C) Copyright Microsoft Corp. 1981, 1990.

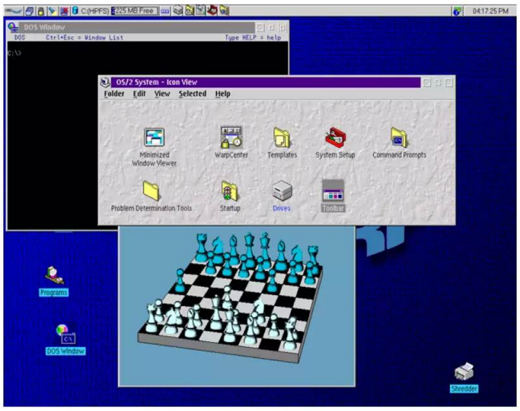
OK

The OS/2 1.3 desktop looks extremely similar to the Microsoft Windows 3.0 desktop that was soon to come.

1989's 1.2 release introduced a more advanced file system with long filenames – at a time when MS-DOS was still eight characters – and 1.2 Extended Edition featured TCP/IP networking.

In 1990, the IBM-Microsoft relationship turned sour. In May, Microsoft released Windows 3.0. Microsoft finally had a respectable desktop, and had achieved a technical advantage by targeting the 32-bit capabilities of the 386 and 486, while OS/2 was still focused on the 16-bit 286. Furthermore, Microsoft's anti-competitive practice of 'bundling' with new computers had begun, while IBM was still selling OS/2 as a standalone product.

The two companies tried to negotiate the future maintenance of OS/2, but each company had differing ideas. The joint development agreement was over.



```
DOS          Ctrl+Esc = Window List          Type HELP = help
C:\>
```

OS/2 Warp had some nifty features here and there, but it never stood a chance against the Windows 9x juggernaut.

OS/2 WARP
Connect
PowerPC
Edition

When OS/2 2.0 was released in April 1992, it retailed for $195. Windows 3.1 retailed the same month for $150.

OS/2 2.0 was the first properly 32-bit release. It featured a new desktop called the Workplace Shell and offered Windows 3.0 compatibility. IBM advertised their product as "a better DOS than DOS and a better Windows than Windows."

OS/2 could now run more than one DOS program at a time, and use a virtual machine to protect the rest of the system from misbehaving applications.

1994's 3.0 release, OS/2 Warp 3 (or just OS/2 Warp), brought a refreshed image with Star Trek-inspired marketing, an improved desktop, more hardware support, enhanced networking, and better multimedia. OS/2 Warp had a serious fanbase, great performance on slower hardware, and was by all means a classic release.

However, 1995 saw the release of Windows 95, and with it came the crushing dominance of Microsoft as we know it. When OS/2 Warp 4 arrived in 1996, it didn't stand a chance. Windows 95 was the new standard and OS/2 didn't support it. OS/2 quickly sank into irrelevance, and more than 1,300 developers lost their jobs.

While OS/2 was little more than a niche on desktops, it was popular in the banking sector and was used very often in automated systems, supermarket checkouts, and ATMs. Some systems still remain in use.

WORKPLACE OS

Going on in the background of the OS/2 story is Workplace OS – perhaps IBM's biggest folly.

The system was based around very grandiose but hard-to-fathom ideas. Research began in 1991 around an idea called the Grand Unifying Theory of Systems that would allow a single computer to run applications from multiple systems, such as Unix, OS/2, or Windows. Four years and $2 billion were spent on this unified vision, which ultimately fell victim to internal politics, over-engineering, and feature creep.

Meanwhile, IBM was trying to pull the business market back from the clutches of Intel and Microsoft, and was putting its weight behind the PowerPC RISC CPU architecture. When Workplace OS was finally announced, it was named OS/2 Warp Connect (PowerPC Edition).

However, the PowerPC platform didn't take off as it was expected to, leaving only a niche market in its wake. Only two developer versions ever saw the light of day – in late 1995 and early 1996 – and ultimately, Warp Connect never hit retail.

EXPANSION As the PC moved beyond its first two generations, its supporting hardware was no longer fit for purpose. New expansion options were required to make full use of the wave of cards and chipsets.

MCA

Despite having spawned the idea of an open architecture for the PC, IBM was losing its position as a dominant PC maker, and wanted to regain some control over the market. Big Blue tried to fight back against the PC-compatibles with a proprietary expansion bus – something that would be superior to ISA and regain financial control via patents and licensing.

In April 1987, IBM introduced the Micro Channel architecture (MCA) with the launch of its PS/2 computer range. These devices were almost a generation faster than existing buses, but required a license for every machine.

MCA was a 32-bit bus, but maintained support for 16-bit hardware. The basic data rate was 10MHz, up from ISA's 8.33MHz, but the 32-bit bus allowed for a throughput up to five times higher than ISA. Later models had twice the performance at 20 MHz.

Bus mastering allowed cards to communicate with each other directly, with performance independent of the CPU. A slot with an extra connector was included for advanced graphics cards, allowing MCA-equipped PCs to go beyond VGA into modes like XGA.

MCA features an early form of Plug and Play. MCA cards had a 16-bit ID that could be read in BIOS or in software. This ID would be compared to a list of other known cards, and the system could automatically configure the card's addressing. Even though MCA cards were nearly twice the price, the theoretical advantage was that installation would be much simpler, thereby saving money on technicians.

IBM's MCA standard was ahead of its time, but held back by its proprietary licensing.

MCA was licensed to multiple companies, such as Dell, Tandy, Research Machines, and Olivetti, for a cut of revenue. However, despite MCA's significant technical improvements, it was largely a flop.

For starters, the automatic configuration system of MCA was regarded as more trouble than it was worth. Given that the system relied on a list of known cards, this list had to be regularly updated with IBM Reference floppy disks. Without the updated reference files, it would lead to boot failures and an error at startup.

Furthermore, the system configuration of each PC would be stored on a floppy, meaning every

VLB, with its extra brown slots, was a huge bodge spanning one side of a motherboard to the other!

NUBUS

Only the cool kids got to use NuBus. And Apple users.

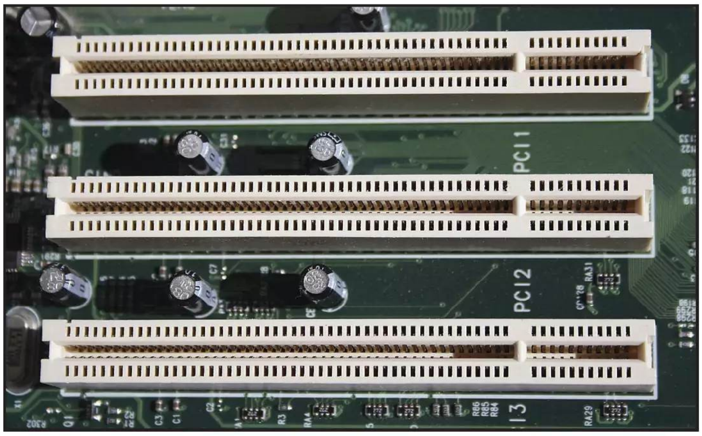
NuBus was an open-standard 32-bit bus, designed at MIT for the NuMachine workstation. Launched in 1987, NuBus was 32-bit at a time when 8-bit and 16-bit buses were still the norm.

NuBus wasn't tied to any CPU architecture, meaning it could be used across a range of systems. It also had an ID scheme that allowed cards to configure themselves at startup, making for an early form of Plug and Play that worked better than IBM's MCA system.

However, this required extra chipsets and made them more difficult and expensive to design. This left them initially in the domain of more premium (and niche) workstations and servers.

NuBus was proposed as an upgrade path during IBM's MCA licensing controversies, but the Compaq-led consortium of IBM-compatible makers decided to go with EISA. Apple, however, recognized NuBus's potential, and adopted the standard for its Macintosh II series and onward.

Its use continued on until Apple switched to PCI in the mid-'90s.



PCI (Peripheral Component Interconnect) was an open standard, developed by Intel, released in 1992.

PC would need to be matched to a specific floppy. This was impractical within a large organization, never mind potential issues surrounding floppies going bad or missing.

The main problem was that the huge market of 'IBM-compatible' clone makers didn't want to pay royalties for IBM's new tech, and stuck mostly with the old ISA standard. It wasn't long until ISA was too slow, even for the clone makers, and a consortium of PC makers developed a new bus: Extended Industry Standard Architecture (EISA). Still at 8.33MHz, EISA was slower than MCA, but still had most of the same features, could use old ISA boards, and avoided licensing royalties.

The two standards fought for dominance, but even IBM ultimately produced some servers with EISA in 1996. Both would be superseded by the eventual adoption of 1992's PCI, developed by Intel.

VESA Local Bus (VLB)

The VESA Local Bus was designed primarily around graphical performance. The VLB standard was introduced during the 486 era in the early '90s. As the PC world moved away from DOS, and into graphical desktops, ISA's 8.33MHz bandwidth had become a limiting factor on video performance.

Increases in video resolutions created the need for a new expansion standard that could cater to the needs of graphical performance. Although MCA would have been up to the task, that came with licensing fees and greater expense, and EISA lacked the bandwidth for advanced graphical applications. To fill the gap, in 1992, the VESA consortium (Video Electronics Standard Association) proposed a new royalty-free standard: VESA Local Bus (VLB).

Although VLB was designed with graphics in mind, other hardware was able to use the slots to their benefit, such as mass storage controllers, which allowed for faster hard drive access.

A VLB slot was an extra connector – usually brown – at the end of a normal ISA or EISA slot. The brown connectors were the same as those used by IBM's MCA, but reversed. After MCA failed to take off, there were plenty of its connectors in surplus.

The multi-slot design allowed more advanced features to be routed through the connector while basic tasks like port mapping and interrupts could be handled by the ISA slot. If the VLB portion was unused, the regular (E) ISA slot that remained could be used as normal.

Even though VLB cards were common, the standard was short-lived. The primary issue was that VLB was designed with the 486 in mind, and reliant on its memory bus design. There were some high-end 386 DX computers with VLB slots – along with the odd Pentium – but for the most part, it was only 486s that had VLB cards. There was probably nothing non-x86.

VLB was also electrically demanding on a 486 CPU, making them less reliable, and bus conflicts were common, which could be catastrophic when used with a hard drive controller. Stability also worsened the higher the front-side bus speed ran, and the cards were inherently massive, making them hard to install and easy to break. When the Pentium era got started in the home market, VLB was quickly abandoned in favour of PCI.

3D ACCELERATION In the mid-'90s, 3D acceleration revolutionised gaming and changed the PC as we know it. Where now we have two main players, Nvidia and AMD, the '90s had a group of companies. Here, we will examine some contenders we lost along the way

Matrox

Matrox is a well-established company, but its foray into the gaming world wasn't a wild success. When the 3D accelerator market exploded, Matrox was very much an 'also-ran' player.

Formed in 1976, this Canadian graphics company has a long history of producing graphical and video equipment. Matrox had made a name for itself in the early '90s with excellent 2D accelerators for graphical workstations.

In 1994, it launched the Impression line. These were early 3D accelerators to be used in conjunction with an existing 2D card. They lacked features like texture mapping, but were aimed at CAD professionals.

By 1995, 3D acceleration in gaming was gaining traction. Matrox recognised that 3D acceleration was the future of the medium, and incorporated its 3D acceleration features into its 2D accelerator Millennium line. However, there was little software support for the Millennium, and 3D-wise, its price and performance weren't stacking up against the likes of 3dfx, Nvidia, and ATI.

In 1996, Matrox released the Mystique. Expanding on its existing architecture, this now had essential 3D features like texture mapping, but also employed cost-cutting to make it more competitive. Regardless, it lacked visual enhancements found in the competition, like bilinear filtering, alpha blending, fogging, and anti-aliasing. Its 3D performance was competitive, but comparatively ugly. Reviews were unfavourable.

In 1998, Matrox responded with the G200 line. These bested the competition in 3D visuals, with full 32-bit colour depth, trilinear mip-map filtering, and anti-aliasing. FPS performance was behind the competition, but still competitive.

The budget Mystique range stacked up badly against 3dfx and Nvidia, being cruelly nicknamed 'the Mystake'.

Unfortunately, it had buggy drivers and poor OpenGL support. For OpenGL games like Quake II, it relied on a Direct3D 'wrapper', converting OpenGL system calls into Direct3D's. This made for appalling performance with OpenGL titles. When the G400 line was launched in September 1999, it still wasn't OpenGL native.

The G400 was essentially two G200s with some improvements. Desktop usage was still brilliant, but its drivers were well behind the competition, and Nvidia dominated the market for OpenGL performance. Like numerous models before it, the G400 relied on the CPU for a lot of heavy lifting.

As we entered the 21st century, Matrox fell into obscurity as the market turned into a two-horse race: ATI and Nvidia. Thankfully, Matrox also had its industrial client base and still operates today.

3DFX

Of all the stories in this article, 3dfx represents the biggest rise and fall. This was the company that brought 3D acceleration into the mainstream and produced one of the most iconic pieces of PC hardware ever. Starting in August 1994, this company released its first product, the Voodoo graphics chip, in November 1995.

Initially, the Voodoo chip was only used in arcades, but after a price drop in DRAM, 3dfx entered the home PC market. Initially, 3dfx only acted as a chip builder, and used third-party manufacturers to build and sell its cards. Unable to find sufficient support in OpenGL and Direct3D, they developed their own proprietary API, Glide.

There was one quirk: the Voodoo could only do 3D, relying on a separate graphics card for 2D graphics. A loopback cable had to be used, and being analog, it deteriorated the signal from the 2D card. Regardless, 3dfx beat the competition on price, quality, and performance. By 1997, it was the dominant force in the market.

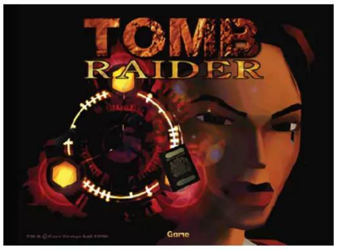
Of course, requiring a second graphics card made life harder for mass-market PC builders, and in August 1997, 3dfx tried to rectify this problem with the Voodoo Rush. This integrated 2D graphics with the Voodoo chip, so everything was on one card. However, shoddy design and bad resource sharing resulted in a performance hit of about 10 percent. The market didn't go for it, and the Rush was 3dfx's first commercial failure.

Undeterred, 3dfx created the Voodoo2. Released in March 1998, it was 3dfx's greatest hit, and became the most iconic 3D accelerator ever. The new card went for a brute-force approach, with a near double clock rate (90MHz over 50MHz), and an increased chip count, including a second texturing unit.

The Voodoo2 still required a separate 2D card and loopback cable, but this didn't put off the market. Some gamers even used this to their advantage, linking cards like a Matrox G200 with their Voodoo2 for the best combination of 2D and 3D performance.

The Voodoo2 introduced SLI – Scan-Line Interleave – which spread the processing burden across two cards, attached by a data cable. An SLI was the ultimate setup for gamers, affording the greatest bragging rights.

The Voodoo2, however, was the best things would get for 3dfx. When 1999's Voodoo3 came around, the market was changing. It was an all-in-one card, removing the need for a dedicated 2D card. The new card was, to put it crudely, essentially two Voodoo2s squeezed onto one card, with much higher clock speeds (143, 166, or 183MHz).



Even Glide was a reasonable success, with a number of games using the API for their ultimate version.

However, Nvidia was on the rise, mopping up OEM sales with its well-priced Riva TNT. The Voodoo3 was still competitive, but there was no longer a major advantage over the competition.

3dfx shot themselves in the foot by acquiring video card builder STB Systems and moving their production in-house. Until this point, 3dfx had relied on third-party makers to build and ship their cards. They became competitors, and turned to Nvidia for chipsets.

Sales of the Voodoo3 were respectable, but ATI and Nvidia pulled ahead. By the time the Voodoo4 and Voodoo5 came our, 3dfx was facing bankruptcy.

Its cards featured more advanced architecture and better image quality, but these changes weren't enough. Only two models made it to market due to bugs.

3dfx was bought by Nvidia in December 2000, product support ceasing in February 2001. ATI was acquired by AMD in 2006, and now operates under that brand.

POWERVR: THE DARK HORSE

A name that's rarely mentioned is PowerVR – a division of Imagination Technologies (formerly VideoLogic). PowerVR was in the 3D accelerator market from the beginning, and is still going today.

The brand was never famous in the PC market, but it did very well in consoles and arcades – where it was eventually chosen over 3dfx to power Sega's Dreamcast – and has powered many smartphones, wearables, and tablets.

Of interest to PC history is PowerVR's combination of tile-based deferred rendering and Hidden Surface Removal, which works out which parts of a 3D image are visible and then renders visible surfaces. This allowed for competitive performance at lower clock speeds, which made for some very attractively priced cards.

3D PROPHET 4000XT 64MB PCI
Hercules

Hercules 3D Prophet 4000XT 64MB PCI.

LESSONS TO BE LEARNED

We've mourned discarded technology of the past, but what lessons can be drawn from their failures?

We live in exciting times, where one company no longer dominates the computing landscape, and people use everything from traditional desktops to voice-activated smart watches. AI is the new competitive battleground, even if we're still working out what to do with it. When cars have competing smart systems, smartphones have two big players, and the PC is morphing into new form factors.

With all this uncertainty, we can look into the past and ask, what patterns can be observed that may help predict the future?

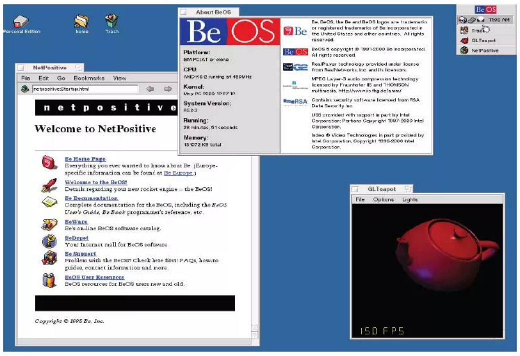
The best product doesn't always win

There is a mistaken belief in free-market economies that competition will single out the best product, but it's not that simple. This is a world where VHS beat Betamax, and people grumble about Windows instead of using something like OS/2, BeOS, or Unix. The market leader will often be the company with the best supply chain, support network, and, the most aggressive business practices.

OS/2 was in most ways a technically superior product to Windows (certainly more stable), but was hampered by poor marketing and business decisions. Windows was stable enough and used ruthless anti-competitive business practices – it bundled its operating system with almost all new PCs.

It doesn't always have to be faster

It just has to be good enough, and at a reasonable price. Performance has only a limited influence over the market. Although people love



BeOS was a beautiful system that was almost adopted by Apple and hampered from PC desktops by Microsoft.

to have the latest and greatest – and being faster than the competition certainly helps – factors like ease of use, availability, and software support have a greater influence than outright performance.

EISA is a good example, which won out over MCA and NuBus, both of which were faster and technically superior. NuBus was even an open standard, but EISA was backward-compatible with ISA, cheaper, and easier to work with.

People are resistant to change

Companies may want to move to newer, faster technologies, but actual computer owners may not be so keen. If something is good enough, then users are willing to keep a platform going for much longer than expected, especially if the software library is enormous and the platform easy to deal with.

New technologies require money and training, and many customers simply don't see the need to change. Their current setup may be fine as is, and the new product not perceived as helpful.

For example, the Commodore 64 remained in use well into the mid-'90s, despite Commodore adopting 16 and 32-bit architectures years earlier. Apple poured resources into more advanced architectures, but it was the faithful Apple II that kept the company afloat.

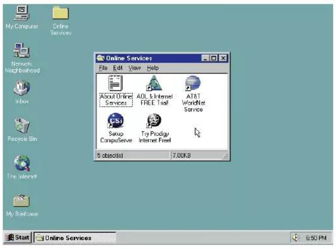
In the PC world, Microsoft got things very right with the design conventions for Windows 95: a taskbar with a Start button and menu, with the Maximise, Minimise, and Close buttons in the top-right of each window. Job done. It got the design so right, in fact, that we're still using the same design conventions almost 30 years later.

Microsoft has tried moving past these conventions, but it has always been met with user outcry. Windows 11 has moved the Start button into the centre, and even that has people grumpy. Even in the Linux world, which prides itself on quirky alternatives, these Windows 95 conventions are dominant.

Open standards versus proprietary

In the long run, markets tend to favor standards that are more open. A proprietary standard is tied to the bank account of the company behind it – when there is a common standard to support, it fights the combined forces of its competitors.

Apple's products may have a more prestigious image, but there are more PCs in the world than there are Macs, and more Android phones than iPhones. If we start with the PC, IBM – who designed the PC standard – only had a hold over the market for a few years. The 'IBM-compatible' clones wore away at IBM's monopoly, and the IBM badge lost its prestige against high-end models from the likes of Compaq and Hewlett-Packard.



Windows 95 gave us the desktop conventions we're now used to, and Microsoft can't get rid of them.

The irony is that IBM designed the PC as an open standard, but tried to lock it down with their own proprietary BIOS and software. Once third parties had reverse-engineered IBM's BIOS, it opened the floodgates to clone makers who offered cheaper products.

If we look at graphical APIs, 3dfx's Glide offered substantial performance and visual benefits over OpenGL and Direct3D. But as competing hardware got faster and more sophisticated, Glide became increasingly irrelevant, and OpenGL and Direct3D the adopted standards for 3D acceleration.

Looking at internet standards, Microsoft's Internet Explorer dominated web usage for many years. But that browser is now a distant memory. Likewise, Adobe Flash used to be on almost every major website. Now, it is an amusing anecdote from history, and the world has long since moved on to HTML5.

One possible exception is proprietary standards that become so common, they get reversed-engineered and turn into something that's almost an open standard themselves. Two examples are Fraunhofer's MP3 and Microsoft's Word 'Doc' format, which are supported by almost every piece of open-source software in their respective fields.

Microsoft DOS is arguably another example, and as Windows ages while Wine and Proton mature, Windows software may soon fall into the same category, acting as a lingua franca between systems. ■

HOW 'OPEN' ARE WE TALKING HERE?

There's obviously a distinction to be made between something being more open than a competitor, and something being genuinely open.

In no way could Windows be classed as open-source (or indeed, DirectX!), but it embraced the open nature of the PC better than OS/2. Where Windows targeted clone machines and their hardware, OS/2 focused on IBM hardware with little support for third-party products, so OS/2 couldn't run on many clones where Windows ran perfectly.

Genuine open source is growing in popularity, but absolute dominance – at least in more immediate terms – is likely to come from a corrupted version of an open standard.

If you take a browser like Chromium, which is open-source, it's actually its proprietary-extended big brother, Chrome, that is the all-powerful, world-dominating force. And while Linux may power Android and ChromeOS, they're both more stripped-back, sleazy versions of Linux – like Linux, but without the benefits of open-source.

PC BUILDER

From the front lines of the Australian PC market

System news

CES delivers again, and Mark Williams is excited for the year ahead in PCs.

The Consumer Electronics Show (CES) kicked off the new year and boy are there some great products on the way. AMD and Intel were both showing a slew of new CPUs across desktop, laptop and even handheld markets, but it was Nvidia with its keynote address that everyone was holding their proverbial breath for.

As expected, it had a lot of AI announcements and initiatives as it soars high on the AI hype, though it was the first part of the presentation that held the most interest for PC enthusiasts – the announcement of its Blackwell architecture powered RTX 5000 graphics card lineup.

It certainly sounded impressive with claims the RTX 5070 could achieve RTX 4090 levels of performance, but that was when everything performance-wise in the presentation became useless. Jensen Huang, Nvidia's CEO, explained that along with RTX 5000 comes a driver feature called multi-frame generation. So, like regular frame-generation but instead of just producing one fake frame to insert, multi-frame generation can generate up to three extra fake frames, effectively giving up to a fourfold boost in performance.

With all the performance slides Nvidia showed having some form of DLSS used in them it made it hard to get a grasp of just how much faster the RTX 5000 series will be. Some analysts have suggested we may only be looking at around a 40% uplift in raw performance, and that's best-case RTX 5090 versus RTX 4090. Chances are the cards lower down the stack will see an even smaller uplift, given CUDA core counts shown at the announcement.

With the RTX 5090 upping the price yet again for its top-level card at US$2,000, at least the rest of the lineup came in a little under expectations which will be a blessing for most customers.

Standing on the other side of the GPU fence was AMD, who many had anticipated would launch its new RX 9000 series card lineup. AIB vendors were at the show with physical products to show off running demos, press had been given pre-briefings before the event, and it all seemed ready to kick off. But during AMD's presentation there was only a single slide briefly mentioning that RDNA4 cards were coming in Q1 of 2025. The bizarre omission from its presentation had many talking. AMD has been talking up the value proposition of RDNA4 and unfortunately, it's CES presentation came before Nvidia's, placing AMD in a tough spot if it was to nail the launch. A position made even worse by the fact that Nvidia didn't show any non-DLSS performance graphs, which while frustrating, was a tactic by Nvidia to keep AMD guessing.

Most assumed AMD simply wanted to wait and see before locking in its product pricing. Something that Frank Azor, AMD chief architect of gaming solutions, admitted afterwards.

The good news is that RDNA4 looks very promising with demonstrations of FSR4's new machine learning model showing significant image quality improvements over that of FSR3, and Azor stating that the performance of the RX 9000 series should pleasantly surprise us.

Nvidia's cards are due to hit the shelves at the end of January, with AMD being said to officially launch RX 9000 around the same time, so strap in, we haven't even gotten to all the CPU's AMD, Intel and Nvidia announced. It's going to be a great year for PC enthusiasts! ■

Mark Williams is an IT professional with a strong interest in voiding warranties.

Market Watch

A sampling of PC systems available this month

DIGITAL MATRIX COMPUTERS RAPTOR LAKE RTX 4060

$1,849

tinyurl.com/APC542DMC

Coming in as this month's cheapest in the round up doesn't relegate this machine to last place in performance. Sporting ten cores and sixteen threads, the CPU here offers up a good degree of multithreading performance though being paired with cheaper DDR4 memory does hamper its true peak performance.

The SSD capacity is perfect, as is the PSU. The 16GB of RAM is adequate for most tasks, however what isn't so adequate is the 8GB of VRAM on the graphics card. These days unless you're only playing eSports titles or lightweight games, it'll keep you bound to 1080p resolutions, which may be exactly what you're after thus making this a good performer for the price.

CPU Intel Core i5-14400F; **COOLER** Deepcool AG400; **MOTHERBOARD** Asus B760M-AYW WIFI D4; **GRAPHICS** Zotac Gaming GeForce RTX 4060 8GB Twin Edge OC; **MEMORY** 16GB G.Skill Ripjaws V DDR4 3600MHz CL18; **STORAGE** 1TB Crucial P3 PLUS M.2 NVMe SSD; **POWER SUPPLY** MSI MAG A650BN 650W; **CASE** Cougar Archon 2 Mesh.

ALLNEEDS COMPUTERS MORTAR

$1,899

tinyurl.com/APC542ANC

This system goes head-to-head with the Digital Matrix system for price, getting there in a slightly different way. The Ryzen 5 7600 CPU with fewer threads is stronger in lighter loads like games giving this system a slightly more targeted specialisation and strength.

The paired 5600MHz RAM isn't ideal for this series of CPUs, so will bottleneck performance a tad, however the big upside is that this system gets 32GB of it meaning it'll age better as memory demands of new software and games increase. Or simply will let you do more at once.

With mostly similar specs for the rest of the system, depending on your needs, the $50 premium here may be very worthwhile.

CPU AMD Ryzen 5 7600; **COOLER** OEM; **MOTHERBOARD** MSI B650M Mortar Wi-Fi; **GRAPHICS** Gigabyte RTX 4060 8GB **MEMORY** 32GB Corsair Vengeance RGB 5200MHz DDR5; **STORAGE** 1TB Crucial P3 NVMe SSD; **POWER SUPPLY** 650W **CASE** Thermaltake View 200.

CPL ONLINE CPL I7 RTX4070

$2,319

tinyurl.com/APC542CPL

Punching higher up the performance ladder the RTX 4070 Super found here makes for a very capable 1440p class card that outpaces the RX 7800 XT in the more expensive JW system. If you like high fidelity gaming with all the bells and whistles turned on, this is hard to pass up.

Unfortunately, to come in cheaper means corners were cut elsewhere, and here it's the CPU and RAM speed. The Intel 12700F in games now falls behind the likes of the Ryzen 7500F, as found in the JW system in games.

Good for the price if you can overlook the outdated platform it's built on.

CPU Intel Core i7-12700F; **COOLER** OEM; Motherboard Gigabyte B760M DS3H AX; **GRAPHICS** MSI GeForce RTX 4070 Super 12G Ventus 2X OC; **MEMORY** 32GB Corsair Vengeance RGB DDR5 5200MHz; **STORAGE** 2TB Kingston SNV2S NV2 M.2 PCIe 4.0 NVMe SSD; **POWER SUPPLY** Gigabyte UD750GM Aorus 750W; **CASE** Antec C3.

JW COMPUTERS NIGHTFALL RX 7800 XT

$2,436

tinyurl.com/APC542JWC

This month's most expensive system is fighting an unfair fight against the CPL system with its older CPU and platform. Using latest generation parts makes the over $100 price gap here easily forgivable.

The Ryzen 7500F is always a good value option for gamers and the Radeon RX 7800 XT has been AMD's price-to-performance king this generation, with 16GB of VRAM giving it longer legs into the future than the RTX 4070 or Super variants it sits between for raw performance.

Otherwise, the 32GB of RAM is at the right speed, and the 2TB SSD and 750W PSU are ideal here too. Sat in a B650 motherboard, this system is one you can happily upgrade for years to come.

CPU AMD Ryzen 5 7500F; **COOLER** Cooler Master Hyper 212 Spectrum V3; **MOTHERBOARD** Asus Prime B650M-A WIFI II; **GRAPHICS** Asus RX 7800 XT 16GB OC; **MEMORY** 32GB Kingston Fury Beast RGB DDR5-6000; **STORAGE** Kingston 2TB NV2 PCIe Gen4 SSD; **POWER SUPPLY** 750W; **CASE** DeepCool CC360 ARGB.

Blueprints

Value- and performance-driven hypothetical builds

Budget. A perfect balance between price and performance.

These builds are made with you in mind. In almost all scenarios, the majority of the components between the systems are interchangeable, bar the CPU and motherboard combos. That means you could take our AMD budget build as your template of choice, and mix in the RX 7600 GPU. Alternatively, you could pick a component from our mid-range system and pop it in the budget one. As long as those mobo and CPU picks remain concrete, you should be golden, although bear in mind that the B650-S WiFi listed below doesn't have PCIe 5.0 support, so your M.2s will run slower if you pick up a drive on the new standard.

This month, we've seen a number of price hikes sweep across pretty much all of the components. As we write this, Black Friday has passed, and so the market's recovering from its budget-busting deals shenanigans, with prices returning to relative normality in the meanwhile.

It's also a bit of a time of change; Intel's launching a new round of graphics cards shortly, and Nvidia has just announced new GPUs at CES. As such, a lot of stock is starting to reach end of life, particularly some of the early RTX 40 series models. It's becoming difficult to find good pricing, and stock is disappearing.

That aside, we're holding on fast to some of that last-gen CPU goodness from both AMD and Intel, as the savings are still far more potent than the potential performance upticks you'll find in the latest generations, bar a few outliers.

With all that in mind, our budget builds have remained reasonably stable. Our secondary SSD saw a price bump, so we've opted to swap it for the KLEV – the cheapest alternative at that spec that's generally available. A quick change for the Intel's motherboard, avoiding a price hike, and likewise for the GPU on our AMD build, and we've managed to limit the price increases for our budget RRPs down by $22 for AMD and $71 for Intel.

AMD BUILD Approximate Price **$1,415**

Case		Phanteks XT View	$129
PSU		Thermaltake Litepower Gen3 650W 80+	$79
Mobo		MSI PRO B650-S WiFi	$279
CPU		AMD Ryzen 5 7600	$319
GPU	NEW	**Sparkle ORC OC A750 8GB**	**$259**
RAM		Team T-Force Vulcan Alpha 32GB (2x16GB) 6000MHz CL38 DDR5	$149
SSD		500GB Crucial P3 Plus PCIe 4.0 M.2	$56
SSD	NEW	**1TB Klevv CRAS C910 PCIe 4.0 M.2**	**$85**
OS		Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60

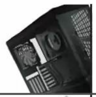
Intel BUILD Approximate Price **$1,545**

Case		Phanteks XT View	$129
PSU		Thermaltake Litepower Gen3 650W 80+	$79
Mobo	NEW	**Asrock Z790 Lightning WiFi**	**$279**
CPU		Intel Core i5-14400F	$259
GPU		Gigabyte Radeon RX 7600 Gaming OC	$429
RAM		Team T-Force Vulcan Alpha 32GB (2x16GB) 6000MHz CL38 DDR5	$155
SSD		500GB Crucial P3 Plus PCIe 4.0 M.2	$55
SSD	NEW	**1TB Klevv CRAS C910 PCIe 4.0 M.2**	**$85**
OS		Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60

AMD BUILD Approximate Price $2,779

Case		Hyte Y40 ATX Mid Tower	$195
PSU		850W Thermaltake Toughpower GF A3 80+ Gold	$145
Mobo	NEW	**Gigabyte X870 Eagle WIFI7**	**$459**
CPU		AMD Ryzen 7 9700X	$535
Cooler		Noctua NH-D12L Chromax.Black	$140
GPU		Asus Dual Radeon RX 7700 XT OC Edition	$629
RAM		32GB (2x 16GB) TeamGroup T-Create Expert @ 6,400 C32	$329
SSD	NEW	**1TB Lexar NM790 M.2 PCIe 4.0 SSD**	**$119**
SSD		2TB Silicon Power UD90 M.2 PCIe 4.0 SSD	$168
OS		Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60

Intel BUILD Approximate Price $2,713

Case		Hyte Y40 ATX Mid Tower	$195
PSU		850W Thermaltake Toughpower GF A3 80+ Gold	$145
Mobo	NEW	MSI Pro Z790-VC WiFi	$459
CPU		Intel Core i7-14700F	$499
Cooler		Cooler Master MasterLiquid ML360L ARGB V2 360mm AIO	$135
GPU	NEW	**MSI Ventus 2X OC RTX 4070 12GB**	**$829**
RAM		32GB (2x16GB) Silicon Power Xpower Zenith Gaming @ 6000 C30	$164
SSD	NEW	**1TB Lexar NM790 M.2 PCIe 4.0 SSD**	**$119**
SSD		2TB Silicon Power UD90 M.2 PCIe 4.0 SSD	$168
OS		Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60

Mid-range. A game-ready machine that can also handle demanding work.

On the mid-range front, changes and availability have been more dramatic. This is what we were talking about earlier when it comes to those RTX 4070 cards being harder to come by. Our PNY RTX 4070 from last month is no longer readily available for sale, and as such, we've gone for MSI's Ventus 2X OC.

Another major change this month is our primary OS SSD. Last issue, we featured Corsair's entry-level MP600 Elite (still as confusingly named as the MP700 Elite we reviewed on page 44); sadly, however, that's jumped up in price since then. We've opted to ditch it across both builds, and grab the tried and true Lexar NM790 in its place. Available for just $119, it mitigates that price increase quite nicely without sacrificing performance.

On our AMD system, we swapped out the motherboard, shifting to Gigabtye's X870 Eagle WiFi 7. Not only does it have a slightly better power delivery system than last month's Asrock pick, it also comes with WiFi 7. The Asrock board went up a few dollars this month, so we save some money by going for the Gigabyte here.

As for our Intel system, aside from the GPU and SSD change, we did look around at alternatives to the venerable Cooler Master MasterLiquid ML360L ARGB V2 360mm AIO, but the search was fruitless – this Cooler Master continues to offer remarkable value for a 360mm AIO at just $135.

We owe you an apology, though, last month we listed the Noctua U12S chromax.blackcooler in our AMD build at $535. That is very, very wrong. As you can see it sells for $140. That was a typo we'll just blame on the Christmas rush and shortened production period to accomodate a much needed break.

With those slight tweaks and adjustments, we've managed to keep pricing on our mid-range fairly stable, with the AMD build easing up by $185, and our Intel system up by just $25. The status quo has returned.

High-end. The ultimate do-anything-with-ease PC.

And then we get to the Turbo builds and what carnage this has been this month. So, what's the issue here, particularly given the lack of overall changes? Well, let's start with the cold, hard facts. Our Intel system has shot up by $378 in total. Now, in any other scenario, if that were to happen, we'd begin by identifying the culprit parts and swapping them out for cheaper alternatives, ideally without sacrificing performance. However, there have been some problems on that front.

Take last month's graphics card, the PNY GeForce RTX 4080 Super Verto Triple Fan 16GBis now basically impossible to find (though PNY is a niche brand in Australia so that's not a huge surprise). We want to stick with a decent RTX 4080 Super, so have gone with the much more readily available Zotac Gaming Trinity RTX 4080 Super 16GB. Zotac is also a smaller brand, but it's always had good representation here in Australia.

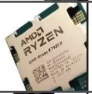
Then there's the cooler; the Asus ROG Strix LC II ARGB 360mm AIO has also gone up. There are some cheaper solutions, but they don't feature an LCD display like the Asus; in fact, almost nothing does below this price point, so we've opted to stick with it for now.

Things are a lot tamer in the land of AMD, although it too suffers from a GPU scarcity. Last month's Asus Radeon RX 7900 XTX TUF Gaming OC 24GB is currently almost impossible to find, so we've switched to the identically priced Powercolor Radeon RX 7900 XTX Hellhound OC 24GB.

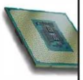
Thankfully, the AMD system has seen pricing stability across the bulk of its components to keep things balanced. That's all added up to steady the price rises of the other units, and the total price has only increased by $63 as a result. A win for Team Red at last.

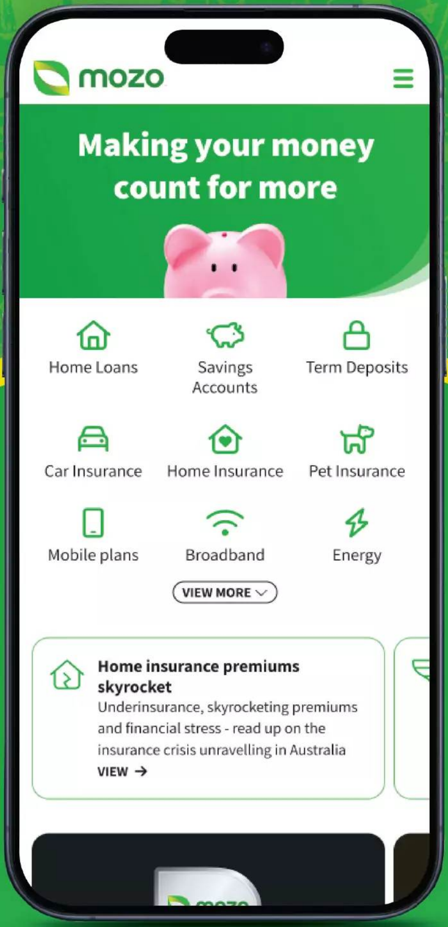
As for why we chose the 7950X over the X3D? Well, right now, even though it's the last generation, the 7950X3D can be all yours for the low, low price of $849. Yes, we suspect that scalpers are having a bit of a meltdown and just buying up processors with the X3D moniker due to AMD's supply issues with the highly popular 9800X3D. What a time to be a PC enthusiast, right? Some things never change...

AMD BUILD **Approximate Price $4,673**

Case		Phanteks Enthoo Pro 2 Tempered Glass	$289
PSU		Phanteks Revolt 1000W Platinum Fully Modular Power Supply Black	$329
Mobo		MSI MAG X670E Tomahawk Wi-Fi AM5	$458
CPU		AMD Ryzen 9 7950X	$849
Cooler		Nzxt Kraken 360	$249
GPU	NEW	**Powercolor Radeon RX 7900 XTX Hellhound OC 24GB**	$1,549
RAM		64GB (2x32GB) Teamgroup T-Create Expert @ 6000 C34	$319
SSD		2TB Crucial T700 PCIe 5.0 M.2	$389
SSD		2TB Lexar NM790 PCIe 4.0 M.2	$182
OS		Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60

Intel BUILD **Approximate Price $4,814**

Case		Phanteks Enthoo Pro 2 Tempered Glass	$289
PSU		Phanteks Revolt 1000W Platinum Fully Modular Power Supply Black	$329
Mobo	NEW	**MSI MAG Z790 Tomahawk Max**	**$459**
CPU		Intel Core i9-14900KF	$689
Cooler		Asus ROG Strix LC II ARGB 360mm AIO	$349
GPU	NEW	**Zotac Gaming Trinity RTX 4080 Super 16GB**	**$1,749**
RAM		64GB (2x32GB) TeamGroup T-Create Expert @ 6000 C34	$319
SSD		2TB Crucial T700 PCIe 5.0 M.2	$389
SSD		2TB Lexar NM790 PCIe 4.0 M.2	$182
OS		Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60



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The problem solvers

The *APC* team field problems across the spectrum of devices and software. Learn a new trick or fix you can use.

AI image generation

I've started using Adobe's Firefly AI image generation system (https://firefly.adobe.com) to produce photo-realistic images to my specifications. However, despite my best efforts, I frequently struggle to provide a prompt that will deliver an image suitable for my needs. What tips can you offer for improving the output that Firefly produces?
Marcus Lyles

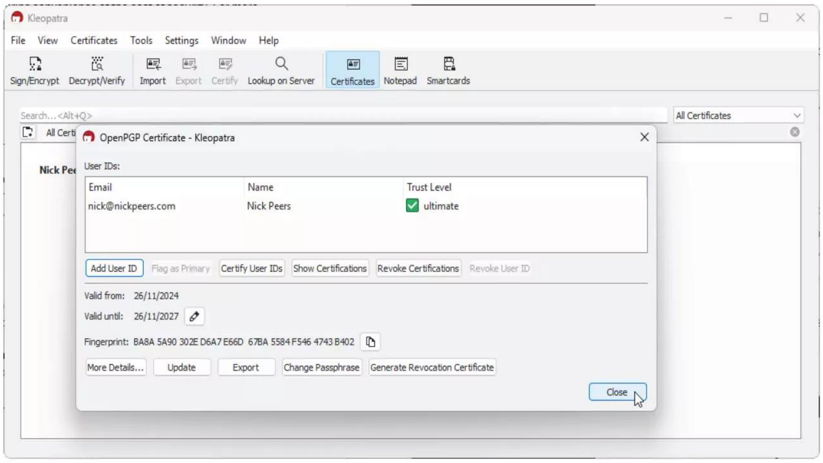
APC Responds: While AI image generation is still relatively new, it's capable of some stunning results – except when you start out using it, when you find yourself never quite able to capture what you're looking for. It reminds us of the early days of AI-powered image colourisation, when early training models relied on humans to evaluate their work. Because the engineers involved couldn't properly articulate their feedback, these models kept favoring 'safe' colours like brown over more realistic choices when generating their images.

The breakthrough occurred when a new model was developed – DeOldify – that delegated the role of both generator and evaluator to the computer, effectively handing over the training of both creator and critic to the other AI tool. It wasn't long before the critic's more precise observations delivered improvements to the images being generated, resulting in the generator producing more realistic colours using a wider range of hues.

How does this relate back to your problem? Simple: rather than articulate what you need yourself, delegate the role to another AI model. *APC* has enjoyed some success using ChatGPT (**https://chatgpt.com**) to help write prompts to deliver the images we sometimes run. Start by describing what type of image you want in ChatGPT, and ask it to create a prompt for Firefly.

You'll immediately notice that ChatGPT produces a more descriptive prompt than your initial effort. Feed this into Firefly, then save the images it generates to your drive, before uploading them all in one go to ChatGPT, and ask it to evaluate each image against the original prompt. It'll tell you which one looks the most realistic, plus give you an idea of what works in each image and what doesn't. Crucially, it'll then offer to produce a refined prompt based on its own evaluation, which you can then feed back into Firefly to hopefully produce images closer to those you're looking for, which you again feed back into ChatGPT to see what's improved and what still needs tweaking.

As with all AI models, neither Firefly nor ChatGPT are infallible – review ChatGPT's prompts and its feedback, correcting it when you spot mistakes. Also, don't be afraid to manually tweak the prompts yourself in Firefly rather than go to and fro with ChatGPT, but be sure to provide any revised prompts when asking for its feedback on the images.



User IDs:

Email	Name	Trust Level
nick@nickpeers.com	Nick Peers	☑ ultimate

Valid from: 26/11/2024
Valid until: 26/11/2027
Fingerprint: BA8A 5A90 302E D6A7 E66D 67BA 5584 F546 4743 B402

Gpg4win uses Kleopatra to manage OpenPGP keys.

Clean network entries

My PC occasionally seems to reset my wired network interface for some unknown reason. Now, when I browse to 'Settings > Network & internet', it claims I'm using 'Ethernet 5' to connect. What happened to the other Ethernet connections (1-4)? Can I tidy this up?
Phoebe Eastin

APC Responds: Windows is notorious for creating multiple copies of adapters, particularly when you have virtualisation software installed. You can view them all by scrolling down and clicking Advanced network settings under 'Network & internet' – you'll see any networking component listed here, from wired and Wi-Fi interfaces to Bluetooth, VPN connections, and virtualised network adapters.

You can't delete any adapters from here, but you can rename them to make them more obvious (click ˇ next to the adapter to reveal the Rename button). The best way to delete adapters is via their parent application (such as when uninstalling VPN software or visiting Tools > Network in VirtualBox), but in a pinch, you can also disable or uninstall them via Device Manager under Network adapters. Do so with care – delete your primary network adapter, and you'll lose your internet connection (although selecting Network Adapters and choosing 'Action > Scan for hardware changes' should bring it back sharpish).

Synology Mesh problem

I recently decided to upgrade my old Synology RT2600ac router to try and fix problems with poor reception in part of my home. I

> "I invested in a Synology WRX560, and then set up a mesh network with the RT2600ac acting as a Wi-Fi point to relay the signal to weak parts of my network."

invested in a Synology WRX560, and then set up a mesh network with the RT2600ac acting as a Wi-Fi point to relay the signal to weak parts of my network. The major issue I have is that several of my devices – including my Roku boxes – keep attaching themselves to the router that's farther away, resulting in them being unusable for streaming. How can I fix this?
Christopher P Barnes

APC Responds: Synology's experiments with mesh routers haven't been entirely successful, if we're honest. One of the major issues is when you try to relay the signal over Wi-Fi – it's a problem common to many mesh setups, but the Synology is more vulnerable than most, because you're able to mix and match Wi-Fi 6 with Wi-Fi 5 tech, and it's the older RT2600ac that's holding you back. *APC* would recommend users think twice about setting up a Synology-based mesh like this unless you can connect the Wi-Fi points to the main router via Ethernet, which is rarely practical, given the cables and distances.

But we digress. The issue here is that your network is set up to combine both 2.4GHz and 5GHz bandwidths in a single network, with the router dynamically allocating devices to the 5GHz band for faster performance (and to reduce congestion on the more commonly used 2.4GHz band). Unfortunately, some devices can't handle this, and end up jumping between routers. Sadly, the only solution is to split out the 2.4GHz and 5GHz networks by disabling the Smart Connect feature.

To do this with the Synology router app on your mobile, navigate to Settings > Wi-Fi, and tap the More button next to Primary network, followed by Edit. Flick the Smart Connect switch off, and tap Save to create two separate networks for 2.4GHz and 5GHz devices, ensuring your older devices should now work properly. You may still run into trouble if the two routers are relatively close together, and within range of the device in question. At times like this, you'll need to manually disconnect and reconnect to the network in the hope that it picks up the stronger signal.

Laptop encryption question

Your feature on locking down your PC (Christmas 2024 issue) made me realise that my laptop is incredibly vulnerable. I decided to choose VeraCrypt for encrypting the drive, but I'd also like a tool that makes it easy to encrypt individual files or folders for either transporting via flash drive or sharing with others with whom I can securely communicate a password. What do you recommend?
James B Mendelsohn

APC Responds: Our first thought was to recommend AESCrypt (**www.aescrypt.com**), which lets you create password-protected archives with a .aes extension. Sadly, the tool, once free and open-source, is now only available for $29.99, which we feel is overkill for such a simple tool, particularly one that was free for most of its development.

Thankfully, there is a viable alternative in the form of Gpg4win (**www.gpg4win.org**). This provides OpenPGP encryption for files via File Explorer as well as a plug-in for Outlook (GpgOL – disable this during installation if not required). Once installed, you'll need to set up your own OpenPGP keys – leave 'Run Kleopatra' checked before clicking Finish, and you'll be taken to the Kleopatra frontend for setting up and managing OpenPGP keys.

Click New Key Pair to create your first key, or choose Import to import an existing key. Provide your name and email address, and check 'Protect the generated key with a passphrase' for additional security. By default, the key expires after three years, but you can click Advanced Settings... to change this date or create a non-expiring key by unchecking 'Valid until'.

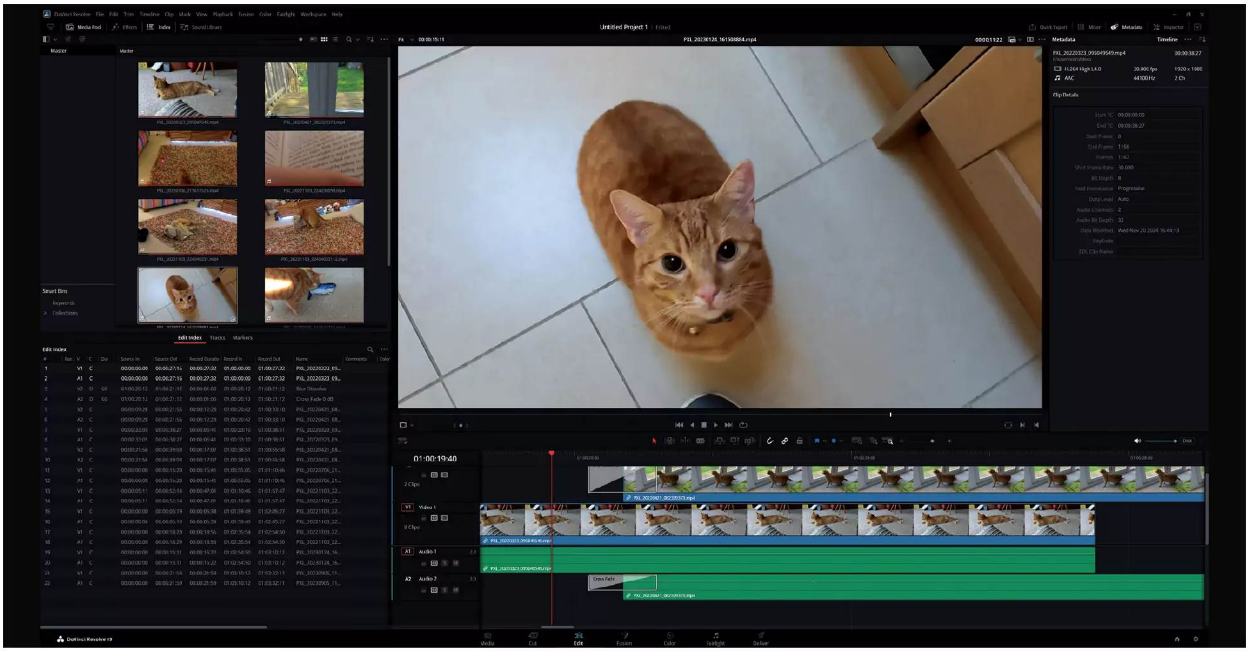
Once you're ready, click OK, enter a passphrase (use your password manager), and click OK. Once the key has been generated, it's ready: right-click a file or folder, and choose 'Show more options' to bring up the right-click menu, where you'll see options for both signing and encrypting the selected file or folder, plus options for decrypting and verifying it.

If you're sharing files with others, they'll need their own implementation of OpenPGP installed on their computer, plus you'll need to share your public key with them (this can be done privately or via a public server, with the latter offering convenience at the cost of security. For more on the process involved, visit **www.gpg4win.org/documentation.html** for detailed documentation.

RustDesk cursor no-show

I've become a big fan of RustDesk. However, I've found one niggle that I hope you can help resolve. I thought it would be great to use RustDesk to demonstrate something on my friend's PC, but halfway through our conversation, as I was becoming frustrated by his inability to see what I was pointing at, I realised the problem: the mouse cursor is only intermittently shown on-screen. Is this an insurmountable problem, or can RustDesk be forced to always show the cursor?
Eric Valladares

APC Responds: This behavior is by design, and only occurs when a remote user has taken control of the computer they're connected to, presumably to prevent confusion on the part of the person receiving help. However, your friend can override this behavior so they can follow your instructions. To do this, they need to open the client, and click the vertical ellipsis next to ID to open the Settings dialog. Select Display and scroll down to 'Other default options'. Check both 'Show remote cursor' and 'Follow remote cursor', which should hopefully fix the problem. Also, consider checking 'Zoom cursor', which may help when demonstrating, too. ■



Instant expert: DaVinci Resolve

Edit and render videos like a pro. Nik Rawlinson shows you how to hit the ground running in the powerful free editing suite.

There are plenty of video-editing tools out there, but DaVinci Resolve is unique in offering a comprehensive professional-grade workflow completely free of charge. It's a well-established tool, too: the software turned 20 last year, and has been used on big-name Hollywood films including *Bohemian Rhapsody*, *La La Land* and *Spectre*.

If you've ever used another non-linear video-editing suite, such as Premiere Pro or Apple's Final Cut Pro, you should have no problem getting started with DaVinci Resolve, as it uses industry-standard tools and workflows. If you're coming from a simpler tool such as Windows Movie Maker or iMovie, the interface might seem daunting at first, but don't be put off. Spend an hour or two exploring what DaVinci Resolve has to offer and you'll soon start to feel at home – and our top five tips on these pages will help you reap high-quality results from the word go.

Is it really free?

Yes, the standard edition of DaVinci Resolve is completely free, with no ads or in-app purchases, and you can use it for as long as you like, to make any type of video. It will run on any PC running Windows 10 or 11, or any Mac running macOS Monterey or later – although bear in mind that video editing is a resource-intensive process, and if you try to run it on lightweight hardware the experience may be sluggish.

There's also a Linux edition, for which the publisher recommends a recent edition of Rocky Linux or CentOS, and an iPad version that runs on tablets with an A12 Bionic chip or later.

Whichever platform you're using, you get an extensive set of tools for editing and enhancing video clips in all popular formats, assembling them into a complete film, and exporting the finished product for online sharing or high-quality distribution. Unless you're a film and TV professional, it will do everything you need – although for those who do fall into that category there's also a high-end commercial version of the software called DaVinci Resolve Studio, which adds enhanced tools for colour grading, media management, speech transcription, subtitle generation, audio editing and more. At $495 it's a big step up from the free edition, but for what you get it's still a very reasonable.

Import and organise your footage with bins

Putting together a project in DaVinci Resolve starts with importing your raw footage into the program. You can add files to the Media Pool by dragging them from the Windows File Explorer to the upper left panel in the Resolve interface, or by clicking the Import Media button above the Media Pool panel (you can also use the keyboard shortcut Ctrl+I).

If you're only working with a handful of clips you can keep them loose in the Media Pool; for bigger projects it can be helpful to organise your clips into different "bins", representing different shoots or subjects. To create a bin, press Ctrl+Shift+N, or select New bin from the File menu.

As well as helping you manage your clips in an individual project, bins offer an easy way to reuse a set of assets across multiple productions. To export a bin for future use, click Media on the toolbar at the bottom of the DaVinci Resolve window; this will change the main view from editing to media management, and you'll see a new sidebar in the lower-left quadrant showing your existing bins. Right-click on one and click Export bin to create a saved copy that you can easily import into future projects, using the Import option on the File menu.

Note that exporting a bin doesn't create new copies of the clips it contains. This is a good thing, as doing so could waste a lot of disk space; rather, a saved bin contains links to the original assets, in whatever location they were in when it was created. After you've saved a bin, therefore, you should avoid moving the original media it refers to – otherwise you'll have to locate the files by hand next time you access it.

Working with multiple tracks

When you first start working with a non-linear editing tool like Resolve, your instinct might be to line all your clips up on a single track of the timeline and trim each one down to create the sequence you want.

However, you can work more quickly, and with more flexibility, by layering your material across multiple tracks. For example, in the screenshot to the right, we're transitioning between a wide shot and a tighter shot showing the main action. Rather than splicing them directly together we've overlapped them, with the wide shot on the lower track and the tighter shot on the track above it. When we play the video, only the uppermost clip is visible, so we don't need to waste time precisely setting the out point of the lower clip.

We can also now independently reposition, trim or extend each clip by dragging it on its own track. To adjust the in and out points of a clip on the timeline, just position the mouse cursor over its start or end, then click and drag left or right.

Even though there's no hard junction between the two pieces of raw footage, we can also still apply transitions between them. You'll find these options in the Cut module, accessible from the toolbar at the bottom of the screen. To apply a transition from the library, click the Transitions tab at the top of the window – replacing the Media Pool – then drag your chosen transition from the pane onto the uppermost media object. You can then fine-tune its behaviour as desired in the right-hand sidebar.

Sound and vision

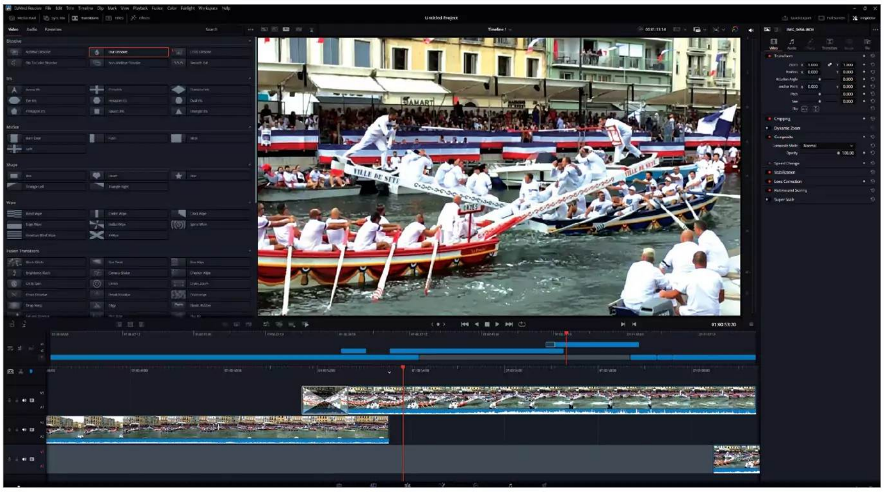
When you place a video clip on the Resolve timeline, its audio component appears as a waveform inside a blue track that runs along the bottom of the video frames. By default, the video and audio are linked, so if you adjust the position or length of one, the other will follow identically, even though it's situated on a separate track.

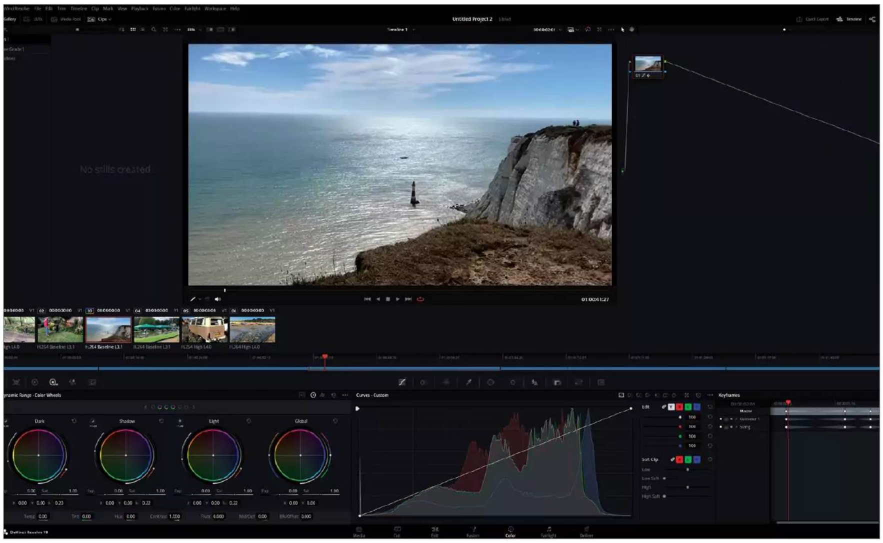
If you don't want this to happen, right-click either the video or audio clip and select Unlink Clips at the bottom of the context menu (alternatively, you can press Ctrl+Alt+L to unlink the selected clips). The video and audio clips can now be edited independently, without affecting each other.

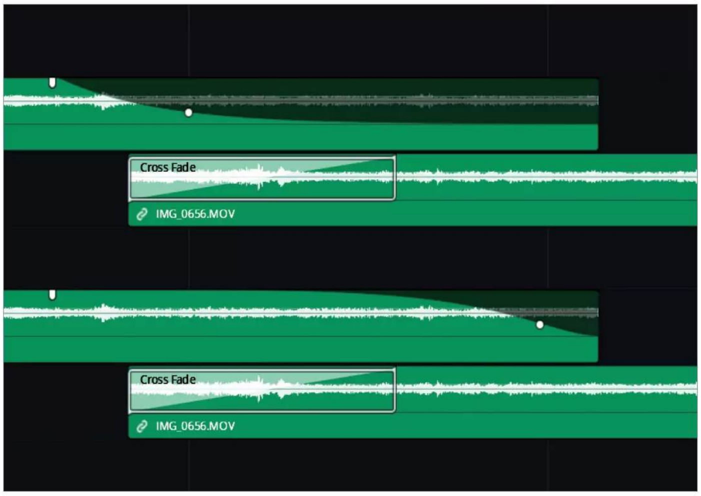
You can also use this technique to delete the video or audio portion of a piece of footage while leaving the rest in place. However, if you just want to silence the audio, a neater approach is to leave it linked and simply reduce the volume to zero. To do this, click on the line that runs horizontally through the centre of the waveform and drag it down to the bottom of the waveform container. The volume will be reduced to -96.86dB and the visual representation of the waveform will disappear. You can drag this line only part of the way down to reduce the volume slightly in your overall mix, or move it up to increase the volume.

You can also use mouse controls to make audio fade in and out. When you hover your mouse pointer over a waveform clip, handles will appear in the top corners over the in and out points, and you can drag these inwards to create a fade; a diagonal line shows the overall volume level as it transitions from 0% to 100%, or vice versa. If your fade is long enough, you'll see a dot at the half-way point on this diagonal (if

BELOW Using multiple tracks helps you make quick adjustments.







ABOVE Using dynamic keyframes lets you gradually apply adjustments. **LEFT** You can adjust the rate of attack of audio fades .

you can't see this, hold Alt and scroll up on your mouse wheel to zoom in on the timeline). This dot is another handle, which you can drag to adjust the shape of the volume curve, so it fades out more gradually or more suddenly, as you can see on the two fades in the screenshot above.

Correct colours using keyframes

It's not unusual for a collection of clips to exhibit significant colour differences – for example, if they were shot in different weather conditions or at different times of day. Applying judicious colour and lighting corrections can reduce these differences and make your finished project feel more like a cohesive whole. This is easy to do in DaVinci Resolve, and by using keyframes you can automate the adjustments so that they fade in subtly at the points you desire.

Once you've imported your assets and arranged them on the timeline, click Color on the bottom toolbar to switch to the colour-adjustment view. If you have any experience of applying colour adjustments to still images using a program such as Photoshop, you'll find some of the tools you encounter here immediately familiar, such as the main Curves control that takes centre stage at the lower centre of the screen. This shows a live histogram, representing the intensity of the individual primary colour elements – red, green and blue – across the current frame, with darker tones (shadows) to the left and lighter tones (highlights) to the right.

Now click one of your footage thumbnails immediately below the playback window, or click a piece of footage on the timeline, and it will be displayed in the playback window. You can use the controls below the main preview window to get a live view, or drag the playhead in the Keyframes panel to advance through the frames that make up the clip.

When you notice something you want to fix, such as unnatural tones, burned out details or areas lost in the shadows, stop dragging. Back up slightly, then right-click in the Keyframes window and add a new dynamic keyframe, which will be dropped in line with the playhead. Now scroll forward to the point where you want the adjustment to take full effect, and insert another dynamic keyframe.

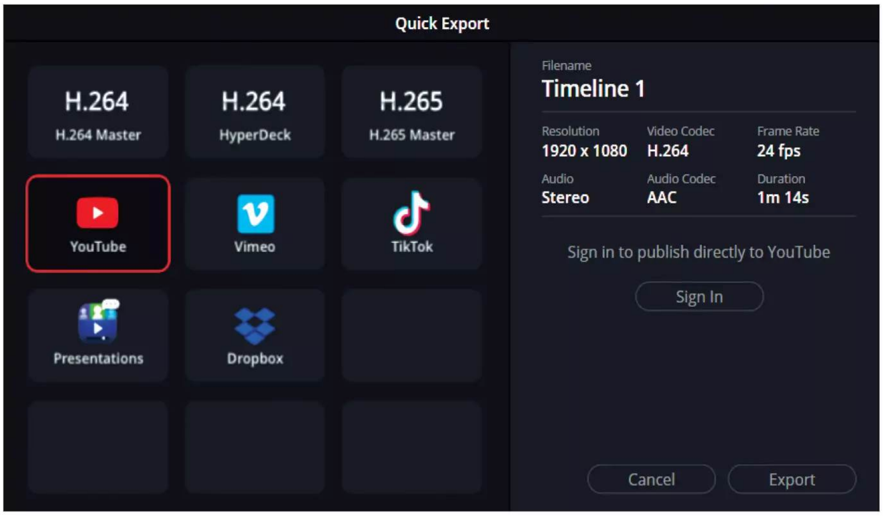
Now, with the playhead on the second keyframe, you can make whatever adjustments you wish using the controls within the Colour module. For example, you might drag the handles within the Curves control to increase or decrease contrast. Or you could drag the centre points on the colour wheels to adjust the tone of the highlights, shadows and other aspects of the frame. It's worth spending some time experimenting to see what you can do, and how combinations of different adjustments affect the overall look.

Once you've got a setting you're happy with, you can scroll back and replay the whole video. The footage will look as it did before until playback reaches the first keyframe; then your corrections will start to fade in, until they're fully applied at the second keyframe. They'll remain active until the end of the clip, or until you create another keyframe and make further adjustments.

If you later want to tweak your changes, just return the playhead to the second keyframe and change the settings – or, if you want to adjust the timing of the change, you can move the keyframes themselves.

Export and share

You can always preview your video directly from the timeline,



Filename
Timeline 1

Resolution 1920 x 1080
Video Codec H.264
Frame Rate 24 fps
Audio Stereo
Audio Codec AAC
Duration 1m 14s

but you might also want to quickly export a rough cut during the editing process, so you can view it in a different context or share it for feedback before the final render. To do this, click Quick Export on the top toolbar, then select a preset from the options that appear, which include formats suitable for YouTube, Vimeo and TikTok. DaVinci Resolve can even handle the upload for you if you sign in to your account through the application.

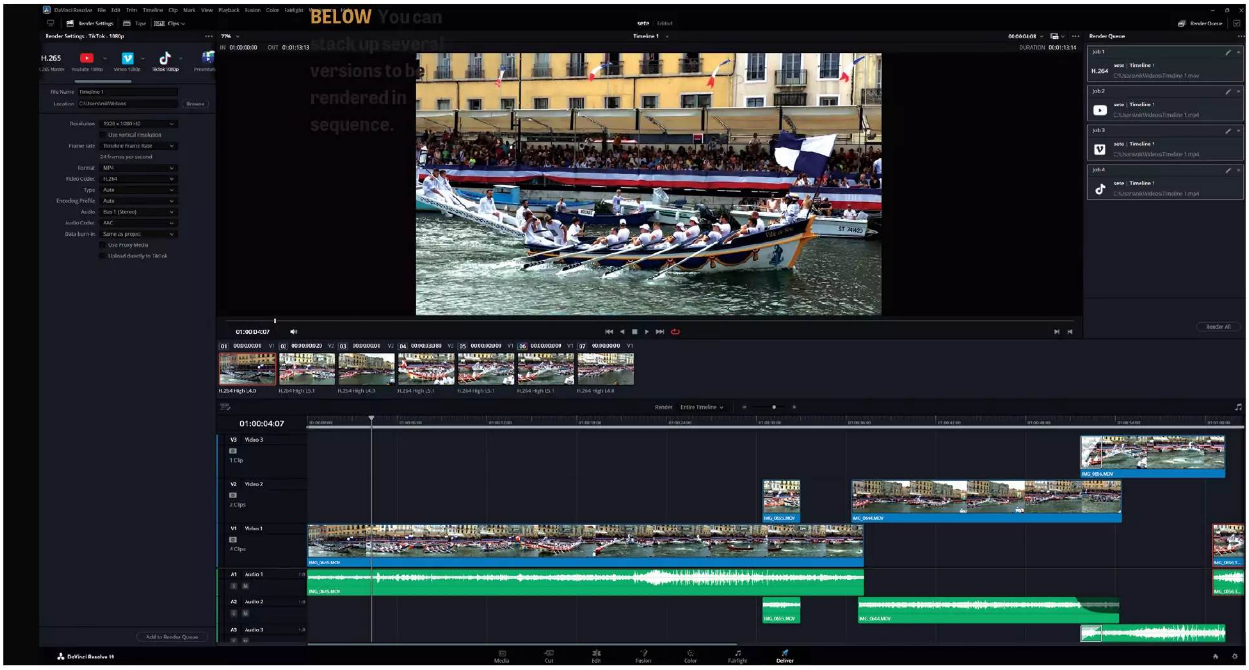
You can use the same process to share it with the world, but if you switch to the Delivery module (click it on the bottom toolbar) you'll find plenty of additional settings in the Render Settings sidebar.

Start by either picking a preset or selecting Custom Export; then, choose whether you want to output your entire assembled video as a single file, or render an individual clip for each piece of footage in your production. Then it's time to select an output format and codec, and make any other adjustments you wish to the format, such as setting your preferred output resolution and even the pixel aspect ratio (square or cinemascope).

Once you've selected your desired settings, click "Add to Render Queue" at the bottom of the Render Settings sidebar. Your job will now appear in the Render Queue panel on the opposite side of the screen, and you can start rendering right away by clicking the Render All button.

However, if you want to create multiple versions of the video – perhaps for different platforms – then you can at this point return to the Render Settings sidebar, set up another job with different settings, and add this to the queue. We added four jobs to the queue – one full-quality version of our video and three smaller versions optimised for different social media platforms. When we click Render All, DaVinci Resolve will set about creating all four versions in sequence. This may take a while, but we can go and do something else while the software works through the render queue.

One last tip: if you're producing multiple renders in one go, make sure you specify a unique filename for each one on the Render Settings File tab. If you tell the software to create multiple exports with the same filename and extension, the later renders will then overwrite the earlier ones. ■



BELOW You can stack up several versions to be rendered in sequence.

Boost games with Lossless Scaling

Ian Evenden has found a clever way to improve performance for windowed games.

YOU'LL NEED

- Lossless Scaling ($10.25 on Steam)
- Games

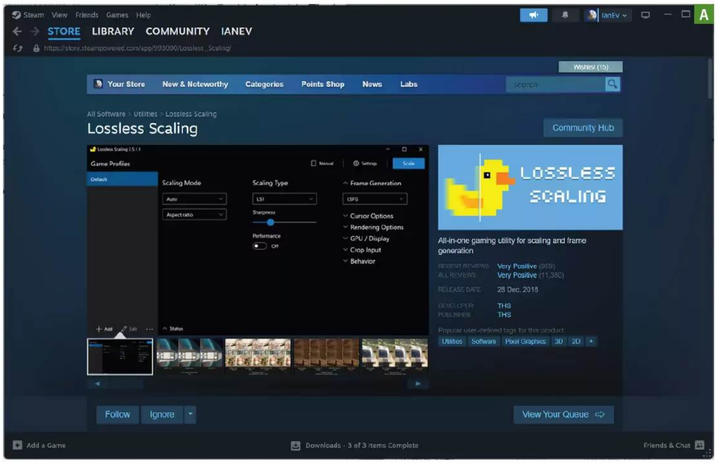
A lot of digital ink has been spent recently on extolling the virtues of resolution upscaling in games. This new technology allows games to run in a lower resolution internally, before being upscaled to a higher pixel density with apparently no effect on performance.

Of course, there's always a cost, and that's why upscaling features are often gated behind hardware upgrades. If you want the latest version of Nvidia's DLSS, which includes frame generation to boost frame rates as well as resolution, you'll need a GeForce RTX 4000-series card. The same thing will almost certainly happen when the 5000 series is released.

There is, however, a software solution that can allow upscaling features to run on unsupported hardware, and it's on Steam. Called Lossless Scaling, and with a cool rubber ducky icon, it's a Windows-only app that can add various scaling modes, sharpness settings, and even performance boosts and frame generation into games that otherwise might not support them, though it requires a pretty powerful card to pull this off.

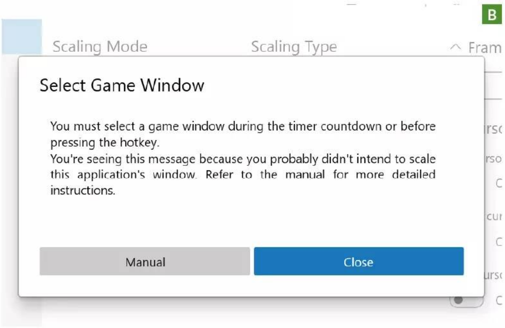
Install

Lossless scaling is available on Steam **[Image A]**, so finding and installing it is an extremely simple process. It's a $10:25 app, but we've seen it go for as little as 80 cents during sales. The software takes up less than 6MB of space on your SSD, too, and despite having been initially launched back in 2018, is under constant development. It received a major update back in August that added support for an X4 frame generation mode that can boost 60fps to 240fps, and offers initial support for G-Sync. One thing to note with Lossless Scaling is that it requires the game to run in a window rather than full-screen, but this is a small price to pay for the increased performance it can offer.


A
Steam View Friends Games Help
IanEv
STORE LIBRARY COMMUNITY IANEV
https://store.steampowered.com/app/993090/Lossless_Scaling/
Wishlist (15)
Your Store
New & Noteworthy
Categories
Points Shop
News
Labs
search
All Software > Utilities > Lossless Scaling
Lossless Scaling
Community Hub
Lossless Scaling 2.5.1.1
Game Profiles
Manual
Settings
Scale
Default
Scaling Mode
Auto
Aspect ratio
Scaling Type
LS1
Sharpness
Performance
Off
Frame Generation
LSFG
Cursor Options
Rendering Options
GPU / Display
Crop Input
Behavior
Add
Edit
Status
LOSSLESS SCALING
Utilities
Software
Pixel Graphics
3D
2D
+
Follow
Ignore
View Your Queue
Add a Game
Downloads - 3 of 3 Items Complete
Friends & Chat

All-in-one gaming utility for scaling and frame generation

RECENT REVIEWS: Very Positive (959)
ALL REVIEWS: Very Positive (11,380)
RELEASE DATE: 28 Dec, 2018
DEVELOPER: THS
PUBLISHER: THS
Popular user-defined tags for this product:


B
Scaling Mode
Scaling Type
Fram
Select Game Window
Manual
Close

You must select a game window during the timer countdown or before pressing the hotkey.
You're seeing this message because you probably didn't intend to scale this application's window. Refer to the manual for more detailed instructions.

It opens as a simple-looking window with a few options visible, but scroll down, and you'll find more hidden out of sight on the right-hand side. To use it, you set the options you want, hit the 'Scale' button, then have five seconds to switch to the game you want to scale before it times out. Judicious use of Alt+Tab may be required **[Image B]**.

Of course, there's a lot more to using the app than that. Once you're comfortable with it, it's possible to create multiple scaling profiles for your games, so you can test different methods against one another in order to get the most out of your rig.

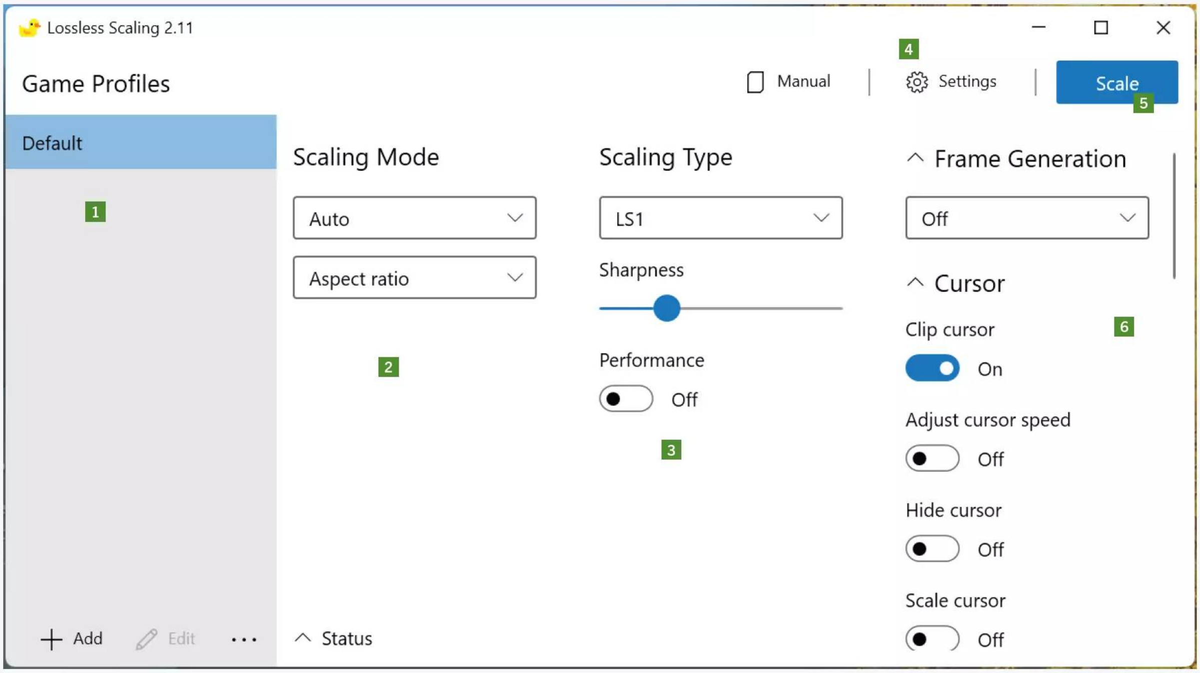
In at the deep end

Having installed the app, what better way to test it out than by picking a few settings seemingly at random, before diving into *Elden Ring*? For a baseline, we set an RTX 3080-equipped PC to run the game in a borderless window at its highest settings in 4K, with ray-tracing on, but auto-detect settings off, to stop it adjusting things on the fly **[Image C]**, which produced a frame rate of around 40fps in an early open area. The game (and the monitor it is displaying on) are restricted to 60fps, which leaves a window of 20fps for improvements. The 3080 was a good GPU that was hamstrung by shortages at launch and too little VRAM throughout its life. Despite having the right sort of cores for DLSS scaling, it doesn't support frame generation, as that tech is restricted to the 4000-series chips.

Further adventures in The Lands Between

Lossless Scaling operates as an app that you launch from Steam before the game you want to play. You set it up, then hit the Scale button, and have five seconds

HOW TO USE LOSSLESS SCALING



Scaling Mode: Auto

Aspect ratio

Scaling Type: LS1

Sharpness

Performance: Off

Frame Generation: Off

Cursor

Clip cursor: On

Adjust cursor speed: Off

Hide cursor: Off

Scale cursor: Off

1 Profiles

Add, remove, and switch between profiles you've defined for your games here.

2 Scaling mode

Keep this in Auto mode unless you know exactly how much scaling you want applied.

3 Scaling type

Choose the scaling algorithm that you want to apply from this list. Performance mode lowers quality.

4 Settings

Change the hotkey you'll use in-game here, and set whether the app opens in administrator mode.

5 Scale button

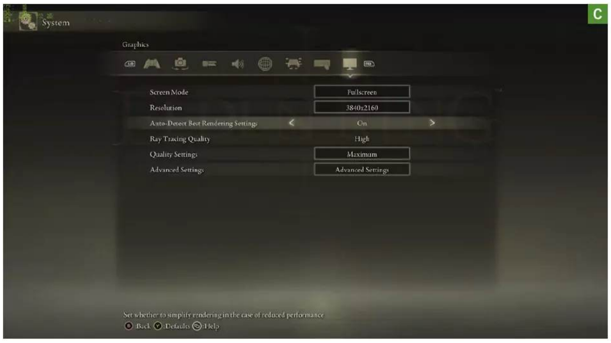
Press this, and you have five seconds to switch to the game that you want it to scale, or it will reset.

6 More options

A long list of tweaks, including the 'HDR Support' switch and a handy FPS counter.

to launch your game (or Alt+Tab your way to it, if it's already running) to get the LS effect. Once in the game, you need to hit a key combination (Ctrl+Alt+S by default) to activate the scaling. The game full-screens, and hopefully the frame rate stays the same or improves.

With the game up and running on 4K ultra graphics settings again, we set Lossless Scaling to the LS1 upscaling algorithm and 2x frame-gen using LSFG 2.3 X2. This has the desired effect, with the frame rate sticking pretty closely to 60fps, according to Nvidia FrameView.



Screen Mode: Fullscreen

Resolution: 3840x2160

Auto-Detect Best Rendering Settings: On

Ray Tracing Quality: High

Quality Settings: Maximum

Advanced Settings: Advanced Settings

Set whether to simplify rendering in the case of reduced performance

A smaller GPU

There's a thread, at the time of writing, on the Steam discussion page for Lossless Scaling simply called, 'Will a potato become a gaming computer?' The answer to that one is a rather flat 'no'. Lossless Scaling runs on the GPU, and therefore consumes a small portion of its resources, which means the game actually has to support your GPU before you can even attempt to improve its performance with scaling. It's not a magical process that will run *Cyberpunk* on a Celeron. With that in mind, we installed it on a desktop mini PC running the Intel Core i9-13900H, 14 cores of Raptor Lake hotness with a tiny Iris Xe integrated GPU with 96 execution units. It's not the weakest iGPU out there, but with a score of around 6000 points in 3D Mark Fire Strike, we're looking at one sixth of the power of the RTX 3080. So what will run on it? *Skyrim Special Edition* auto-detects settings, and sets itself to run at 1080p and Ultra settings with TAA. Wandering around the opening area, we see frame rates in the 30-40s, so there's definitely room for improvement.

To Whiterun!

Our initial settings for *Skyrim* were to leave the scaling mode on Auto and setting the Type to AMD FSR. DLSS isn't going to work on the Intel iGPU, as it's locked to GeForce cards, but AMD is more free with its technology. Setting the game to 4K in the options

box, we click the Scale button. This is where the game gets dreadfully confused; it initially runs only in a thin strip across the center of the screen, then after some Alt+Tabbing, wants to run on both the screens connected to the i9 PC, which reduces the frame rate to a rather disappointing 12 – and this was before the hotkey had been pressed to begin the scaling operation. Exit to desktop, and note that the app's developers recommend turning off your second monitor while using it.

With this in mind, we plunge back in, but at 1080p this time. While Ulfric Stormcloak is busy getting his head chopped off **[Image D]**, we amuse ourselves by turning Lossless Scaling on and off using the keyboard shortcut. This has a striking effect on the game, not only enlarging the window it plays in, but affecting the colors, too, making everything moodier and higher-contrast – this, a quick internet search later tells us, turns out to be an issue with Windows' HDR system, and is fixed by enabling HDR support in LS, which is a switch quite a long way down the list under Rendering. What's more notable, however, is that the frame rate counter displayed in the corner doesn't budge from 30fps – we seem to be getting some extra performance here, though the fan pulling hot air away from the poor i9 is getting slightly more of a workout than it's used to.

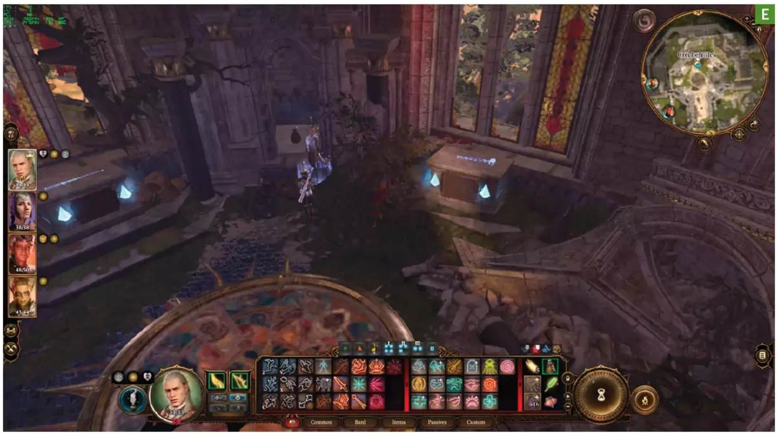
It's worth noting that at the time of writing, Lossless Scaling is using v1 one of the FSR algorithm, while the real thing has reached v3.1. We can hope for an implementation of the newer version, but for now, your results aren't going to be as smooth or sharp with LS as they would be from a native FSR 3.1 game. The fact that it runs in places it wouldn't usually be able to is LS's big advantage.

Frame generation

The app's name may be Lossless Scaling, but the big draw must surely be frame generation for cards that don't natively support it. This frame rate-improving tech has been a big boost, interpolating extra frames between rendered ones to make things appear smoother in motion. It has its drawbacks: not only is there a chance of having artifacts appear on the screen, but as the interpolated frames are essentially a guess on the part of a neural network, it might not be the best idea for twitch shooters or anything that relies on split-second reactions against things that are actually there.

To use it in Lossless Scaling, limit your frame rate to something that's easily doubled. As the monitor we're using tops out at 60Hz, it makes sense to lock a game at 30fps and see if the X2 option in Lossless Scaling can boost it up to 60. There are higher options all the way up to X4 if you choose the LSFG 2.3 algorithm, but doubling gets us into playable territory most of the time.

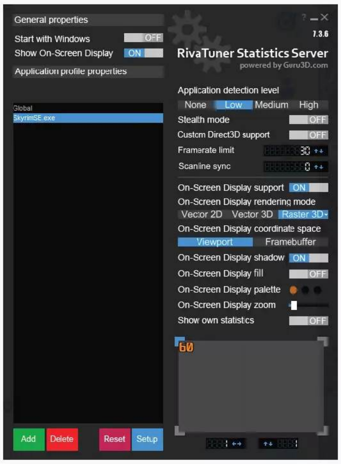
To test this, we fired up *Baldur's Gate* 3 on the i9. It's certified for Steam Deck, so should run on a low-powered system, but getting to 30fps on integrated graphics is a bit of an issue at



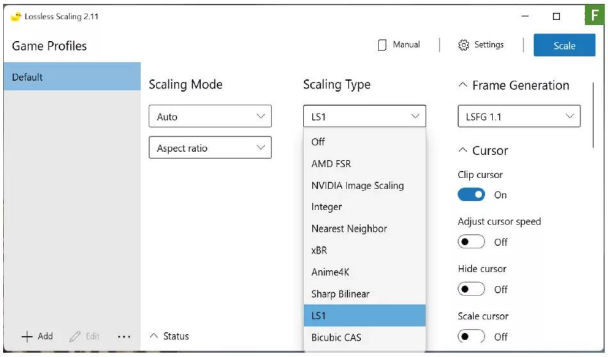
LIMIT THE FRAME RATE

Getting frame generation from Lossless Scaling working with a game involves limiting its frame rate to a number that divides easily into your monitor's maximum refresh rate. With a 60Hz screen, the math is easy enough, but actually getting a game to cooperate is another matter. Some, particularly console ports, have the option built into their menus, but for a game that doesn't there's another option: You can use the RivaTuner Statistics Server (**www.guru3D.com**). Download and install the app, then run it — it will vanish into your system tray. Open it up, and you'll need to add a game's .exe file on the left-hand side using the green 'Add' button. Steam keeps its .exe files in Program Files/Steam/Steamapps/Common by default, but if you can't find a particular game, right-click its entry in Steam's left-hand column, then choose Manage, followed by Browse Local Files. Watch out for games that use launchers, as these are often a separate .exe file than the main game. From here, it's a simple matter of typing '30' (or whatever frame rate you want to limit it to) in the Framerate Limit box in RivaTuner.

Turn off its on-screen display if you don't want an overlay appearing on screen in your game.



Start with Windows OFF
Show On-Screen Display ON
Global
SkyrimSE.exe
Application detection level: None Low Medium High
Stealth mode OFF
Custom Direct3D support OFF
Framerate limit 30
Scanline sync 0
On-Screen Display support ON
On-Screen Display rendering mode: Vector 2D Vector 3D Raster 3D
On-Screen Display coordinate space: Viewport Framebuffer
On-Screen Display shadow ON
On-Screen Display fill OFF
On-Screen Display palette
On-Screen Display zoom
Show own statistics OFF

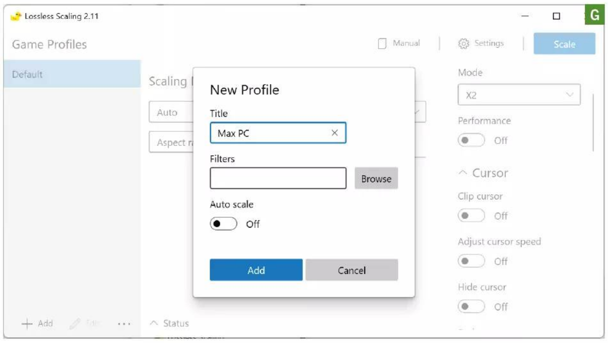

F
Lossless Scaling 2.11
Game Profiles
Manual
Settings
Scale
Default
Scaling Mode
Auto
Aspect ratio
Scaling Type
LS1
Off
AMD FSR
NVIDIA Image Scaling
Integer
Nearest Neighbor
xBR
Anime4K
Sharp Bilinear
LS1
Bicubic CAS
Frame Generation
LSFG 1.1
Cursor
Clip cursor
On
Adjust cursor speed
Off
Hide cursor
Off
Scale cursor
Off
Add
Edit
Status

1080p. With AMD FSR turned on in the game, and detail settings on Low, it spits out 20fps, and a feeling of sadness enters our bones at the sight of all those smeary pixels stretched over a 32-inch 4K screen **[Image E]** when we could just play it in 4K ultra on the 3080-equipped machine. Frame generation in Lossless Scaling could make them move around more smoothly, but no amount of clever processing is going to make it look good. This is where the relatively low-res (1280x800) screen of the Steam Deck is a positive thing, as a 720p video signal looks pretty good on it. The moral of this story is that if you have access to a more powerful GPU, then use that to play games instead of trying software tricks on integrated graphics.

Slave to the algorithm

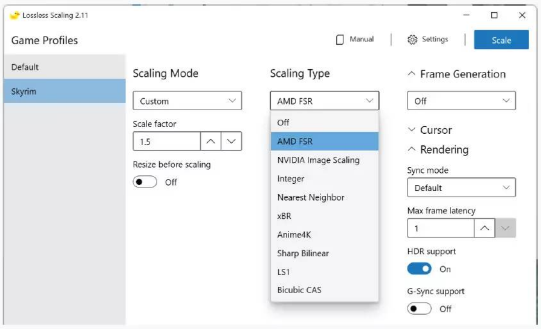
Lossless Scaling offers a choice of algorithms for both upscaling and frame generation. If your game supports a version of DLSS or FSR, then it's worth trying that out, especially if you're using an Nvidia card that supports DLSS, as it will have been chosen to complement the game by its developers, and may work better than something crowbarred in by a third-party app.

If you're running a game that doesn't support it natively, however, then you have choices. Top of the list **[Image F]** is AMD FSR, followed by Nvidia Image Scaling – the company's upscaling solution for cards that don't support DLSS. There are a few other options, some of which sound like they've come straight from Photoshop ("Nearest Neighbor" works well for pixel-art games, for example), but there's something more interesting: LS1. This, as you might suspect, is from the Lossless Scaling team, and uses a "fast general-purpose neural network optimized for scaling factors in the 1x–2x range", according to a post on Steam. It claims "similar performance and image quality to FSR, while surpassing it in many cases", and in practice works well. You'll want to experiment, switching between the LS1 and FSR algorithms (and the others, if you want) to see what gives the best performance in a particular game. Debate rages online as to whether LS1 is superior to FSR, and the answer is that there's no simple answer. As Lossless Scaling uses an early version of FSR, future updates that patch both it and the home-grown algorithm may bring improvements.


G
Lossless Scaling 2.11
Game Profiles
Manual
Settings
Scale
Default
Scaling
Auto
Aspect r
New Profile
Title
Max PC
Filters
Browse
Auto scale
Off
Add
Cancel
Mode
X2
Performance
Off
Cursor
Clip cursor
Off
Adjust cursor speed
Off
Hide cursor
Off
Add
Edit
Status

DLSS VS FSR

DLSS, and indeed any form of upscaling, can be a confusing subject, as there are so many different versions. The Nvidia version – DLSS itself – uses the Tensor cores in a recent GeForce GPU to run a machine-learning model that assists in upscaling, except in the version that runs it on the GPU's CUDA cores. AMD has a technology, FSR (FidelityFX Super Resolution) that doesn't need Tensor cores for its algorithm, and will run on just about anything, including Intel integrated graphics chips. Of course, Intel has a version – Xe Super Sampling – for both the people who bought an Arc card (it can run on other cards, but isn't supported by Lossless Scaling). There's also Sony's solution, PSSR for the PS5 Pro, which runs on its AMD GPU, and may make it to PC in the future. DLSS has Nvidia support, and in its latest incarnations offers frame generation and ray reconstruction, which are transformative when applied to the right game. Choosing the correct version in Lossless Scaling is part of the art of using it: there's no magic solution that fits all games.


Lossless Scaling 2.11
Game Profiles
Manual
Settings
Scale
Default
Skyrim
Scaling Mode
Custom
Scale factor
1.5
Resize before scaling
Off
Scaling Type
AMD FSR
Off
AMD FSR
NVIDIA Image Scaling
Integer
Nearest Neighbor
xBR
Anime4K
Sharp Bilinear
LS1
Bicubic CAS
Frame Generation
Off
Cursor
Rendering
Sync mode
Default
Max frame latency
1
HDR support
On
G-Sync support
Off

Automatic starts

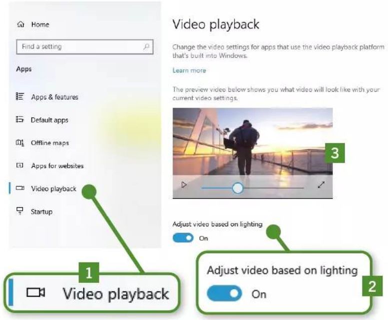
Once you've settled on an upscaling scheme that works for the particular combination of game and hardware you're trying to use, you can save it as a profile so that you don't have to set it up from scratch every time. To do this, open the app, choose the settings you wish to save as a profile, and click the 'Add' button to open the dialog box **[Image G]**. Then give it a name – probably the title of the game, unless you're setting up multiple profiles for the same title. You'll also need to select the game's .exe file, which goes in the 'Filters' box – there's a browse button next to it, so you can find the file, and as the window it opens is already in the Lossless Scaling directory, you should be able to move up one level to find Steam's game folders. Slip on the 'Auto Scale' button to apply the scaling settings every time the .exe file is launched, otherwise it will start without it, and you'll need to hit the keyboard shortcut to switch it on. Profiles can be edited and removed via buttons at the bottom of the interface.

Stop scaling

If you want to stop Lossless Scaling from doing its thing, hit the keyboard shortcut again, and allow the game to return to its original window, or Alt + Tab back to the app and press the Stop Scaling button, which has replaced the Scale button you pressed to initiate the process. ■

Make Windows better

Expert tips for a better experience.


Home
Find a setting
Apps
Apps & features
Default apps
Offline maps
Apps for websites
Video playback
Startup
Video playback
Learn more
Adjust video based on lighting
On
3
1
Video playback
Adjust video based on lighting
On
2

Change the video settings for apps that use the video playback platform that's built into Windows.

The preview video below shows you what video will look like with your current video settings.

WINDOWS 10 & 11

Change video brightness based on lighting conditions

If your computer has a light sensor you can tell Windows to automatically adjust the brightness of videos based on the lighting conditions around you. To check, search for and open Device Manager on your computer, then under Sensors look for a light sensor.

If it has one, now press Windows key+I to open Settings, then click Apps followed by 'Video playback' (1 in our screenshot below, showing Windows 10 – in Windows 11 the option is on the right). Now activate 'Adjust video based on lighting' 2, then see the difference it makes to the video above 3.

Windows 10 & 11

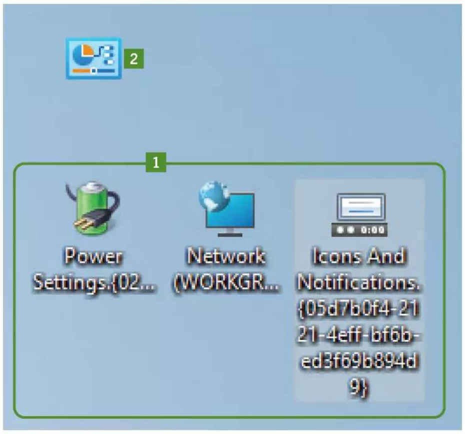
Create mini God Modes for specific sections of Windows.

You may know that you can create the so-called 'God Mode' for Windows by creating a new folder on your desktop, right-clicking it then calling it GodMode.{ED7BA470-8E54-465E-825C-99712043E01C} (copy and paste this from this Pastebin page: **https://pastebin.com/EDEBD2xi**). This changes the folder to the GodMode icon. Clicking it shows you all the settings and options in Windows.

But you can also create mini God Modes for specific sections in Windows, which are handy if you need to repeatedly open them. You create them in the same way, and the folder icon changes to represent the section.

We don't have room to publish all the codes you need to type, but we've added the most useful to this Pastebin page at **https://pastebin.com/RLVKq7Gf**.

In our screenshot we've created God Mode folders for Power Settings, Network and 'Icons and Notifications' (1 in our screenshot), sitting below the main God Mode folder 2.


2
1
Power Settings.{02...
Network (WORKGR...
Icons And Notifications.{05d7b0f4-2121-4eff-bf6b-ed3f69b894d9}

WINDOWS 11

Pause print jobs in Settings

Released on 1 October, Microsoft's 24H2 update for Windows 11 lets you pause print jobs from within Settings. This gives you an alternative to finding the print queue in the 'Devices and Printers' section of the Control Panel.

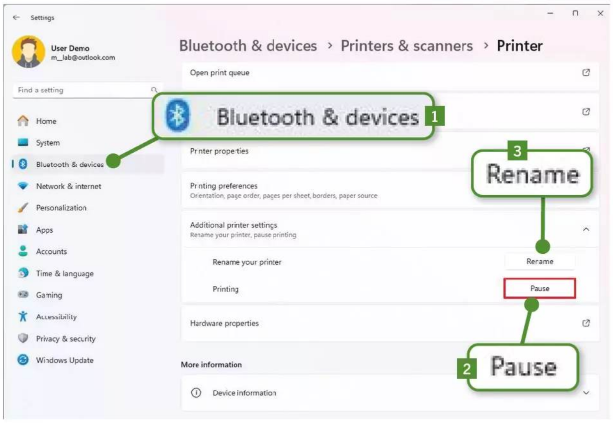
To use the new method, press Windows key+I to open Settings, then click 'Bluetooth & devices' (1 in our screenshot below) followed by 'Printers & scanners' on the right. Select your printer then click 'Printer properties' followed by Pause 2. Click 'Resume' to carry on printing. You'll notice there's also an option to rename your printer 3. Like pausing, you could only do this previously in the Control Panel

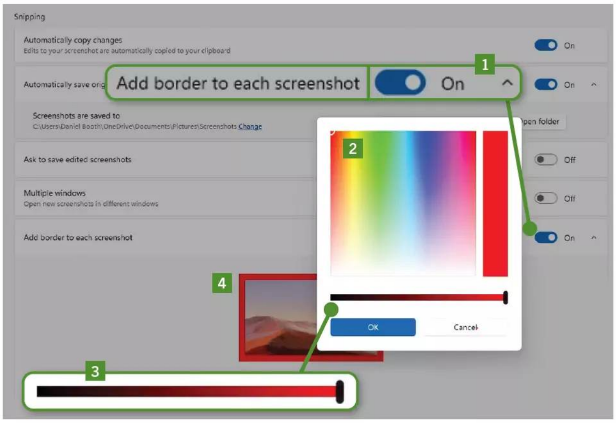
WINDOWS 11

Add borders to screenshots

You can activate a setting in Snipping Tool so that every screenshot it takes is framed by a border. To do this, search for and open Snipping Tool in Windows, then click the three horizontal dots at the top right followed by Settings.

Now click the 'Add border to each screenshot' so the slider turns blue (1 in our screenshot below), then the dropdown arrow. Click the colour square at the bottom then click in the box 2 and move the slider to choose the colour of your border 3. There's another slider further “down for changing the thickness of the border. You'll see what it looks like in the centre 4. ■


Settings
User Demo
m_lab@outlook.com
Find a setting
Home
System
Bluetooth & devices
Network & internet
Personalization
Apps
Accounts
Time & language
Gaming
Accessibility
Privacy & security
Windows Update
Bluetooth & devices › Printers & scanners › Printer
Open print queue
Bluetooth & devices
1
Printer properties
Printing preferences
Orientation, page order, pages per sheet, borders, paper source
3
Rename
Additional printer settings
Rename your printer, pause printing
Rename your printer
Rename
Printing
Pause
Hardware properties
More information
Device information
2
Pause


Snipping
Automatically copy changes
Edits to your screenshot are automatically copied to your clipboard
On
Automatically save orig
Add border to each screenshot
On
1
On
Screenshots are saved to
C:\Users\Daniel Booth\OneDrive\Documents\Pictures\Screenshots Change
Open folder
Ask to save edited screenshots
Off
Multiple windows
Open new screenshots in different windows
Off
Add border to each screenshot
On
2
4
OK
Cancel
3

Make Office better

Expert tips for a better experience.

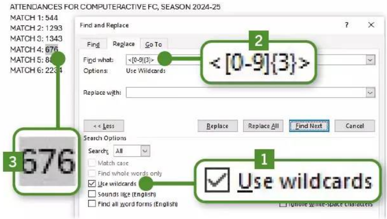
MICROSOFT WORD

Find numbers in documents using wildcards

You may know that you can use wildcard search terms to replace letters in order to broaden your results. For example, searching for b?t in a Word document finds all three-letter words beginning with b and ending with t (bat, bet, bit, bot and but).

You can do something similar with numbers, but first press Ctrl+H to open Word's 'Find and Replace' box. Now click the More button and tick 'Use wildcards' (1 in our screenshot below). Next, in the 'Find what' box type [0-9] and click Find Next. Word will now find all examples of single-digit numbers in your document. Type [0-9]{3} instead and Word will find all three-digit numbers (replace 3 with any number you like).

This is useful, but it finds strings of numbers rather than separate numbers themselves. So if you have both 12345 and 678 in your document, [0-9]{3} will find 123, 234 and 345, as well as 678. To make sure it only finds 678 you need to frame your wildcard with <>. So, typing <[0-9]{3}> 2 will find only separate three-digit numbers 3, and ignore others.


ATTENDANCES FOR COMPUTERACTIVE FC, SEASON 2024-25
MATCH 1: 544
MATCH 2: 1293
MATCH 3: 1343
MATCH 4: 676
MATCH 5: 8
MATCH 6: 22 4

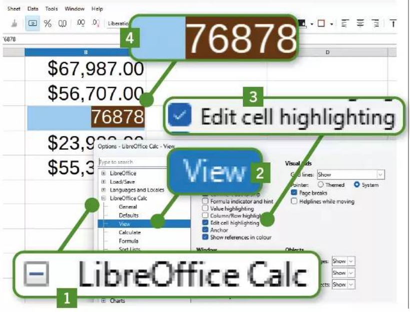
Find what: <[0-9]{3}>
Options: Use Wildcards
Search: All
☐ Match case
☐ Find whole words only
☑ Use wildcards
☐ Sounds like (English)
☐ Find all word forms (English)

Find and Replace
Find
Replace
Go To
Replace with:
<< Less
Replace
Replace All
Find Next
Cancel
Search Options
2
< [0-9]{3}>
1
Use wildcards
3
676

LIBREOFFICE CALC

Add colour background to the cell you're editing

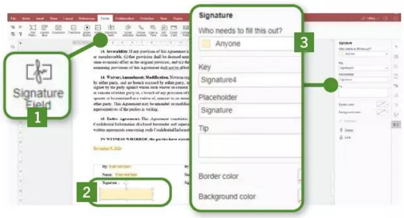
The latest version of LibreOffice Calc (24.8.2, released in late September) adds the option to colour a spreadsheet cell if you're editing it. This helps you see which one you're changing. Turn this on by clicking Tools at the top, followed by Options (or press Alt+F12). Now click the plus sign next to LibreOffice Calc on the left (1 in our screenshot below left), followed by View 2, then tick 'Edit cell highlighting' 3. Click OK to confirm, then start editing a cell and its background will turn blue 4.


$67,987.00
$56,707.00
76878
4
76878
3
Edit cell highlighting
View
2
LibreOffice Calc
1

ONLYOFFICE

Add signature boxes to PDF forms

Version 8.2 of OnlyOffice, released in October, lets you add a box for inserting signatures into PDF forms. Click 'PDF Form' at the top left of OnlyOffice's main page then Signature Field in the toolbar (1 in our screenshot below). Now drag the box that appears into the size and dimensions you want 2 and click outside it when you're done. There are options on the right for stating who should sign the box, and for changing the border and background colour 3. Save the PDF and you're done. ■


Signature Field
1
2
Signature
Who needs to fill this out?
Anyone
3
Key
Signature4
Placeholder
Signature
Tip
Border color
Background color

Microsoft Outlook on the web

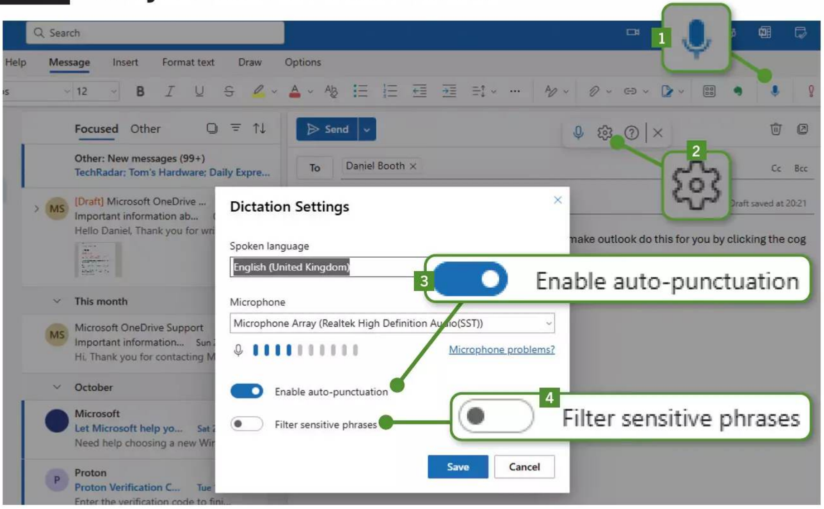
Use your voice to 'write' emails

One of the reasons we don't like the new version of Outlook is that Microsoft has based its design on the online version of Outlook. This is an odd look for a downloadable program, and so we wouldn't blame you for taking Microsoft's hint and switching entirely to the free 'Outlook on the web' (which is the company's official name for the online tool).

It's free at **www.outlook.com** and has a decent selection of features that don't clutter the design. One of these is a dictation tool that lets you speak rather than type your email. Open a new email or start replying to one, then click Message in the top toolbar. Now place your cursor in the body of the email then click the microphone icon at the top right (1 in our screenshot). Start talking and Outlook should recognise what you're saying.

By default, you'll need to add punctuation, but you can make Outlook do this for you by clicking the cog icon 2 and turning on 'Enable auto-punctuation' 3.

You might also want to turn off 'Filter sensitive phrases' 4, which censors swear words and other offensive terms. Click 'Save' to confirm.


Other: New messages (99+)
TechRadar; Tom's Hardware; Daily Expre...
[Draft] Microsoft OneDrive ...
Important information ab...
Hello Daniel, Thank you for wri
Microsoft OneDrive Support
Important information... Sun
Hi, Thank you for contacting M
Microsoft
Let Microsoft help yo... Sat
Need help choosing a new Wi
Proton
Proton Verification C... Tue
Enter the verification code to fini...

To: Daniel Booth
Draft saved at 20:21
make outlook do this for you by clicking the cog

Dictation Settings
Spoken language: English (United Kingdom)
Microphone: Microphone Array (Realtek High Definition Audio(SST))
● Enable auto-punctuation
○ Filter sensitive phrases

Search
Help
Message
Insert
Format text
Draw
Options
12
Focused
Other
This month
October
Send
Cc
Bcc
Microphone problems?
Save
Cancel
1
2
3
Enable auto-punctuation
4
Filter sensitive phrases

Browser tips

Secret settings and best extensions

CHROME

Customise Chrome with colourful new themes

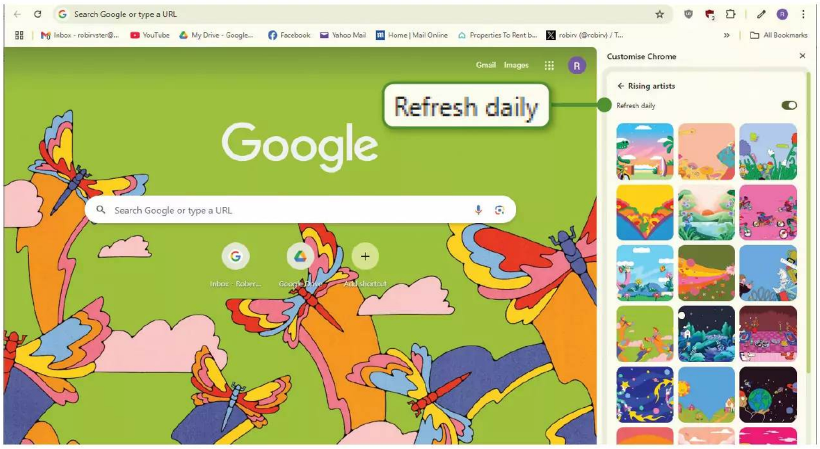
At the start of 2024, Google added an AI option to Chrome that lets you create your own themes for the browser by specifying a subject, mood, visual style and colour. Sadly – like several other new AI tools in Chrome – as we reach the end of the year it's still not available anywhere outside the US.

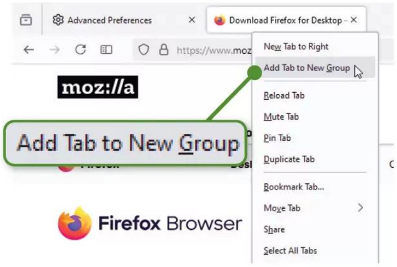
Google has, however, added a new set of (non-AI) themes that let you customise Chrome with colourful designs. Created by "rising artists", these decorate the browser's 'New tab' page and toolbars to add a bit of variety and make it look more vibrant and interesting.

To apply the new themes, click the Customise Chrome button in the bottom-right corner of a 'New tab' page, then click the 'Change theme' button under Appearance. Select the 'Rising artists' tile to browse the 24 new themes, then click one to apply it to the browser.

You can also automatically display a different theme every day by switching on the 'Refresh daily' option (see screenshot below). To return Chrome to its usual appearance, click 'Default Chrome' on the Themes page.

If you'd prefer more seasonal designs, visit the 'Winter wonderland' section of the Chrome Web Store (**tinyurl.com/APC542snow**) to install snowy and Christmas themes.


Search Google or type a URL
Customise Chrome
Rising artists
Refresh daily
Refresh daily
Google
Gmail
Images


Advanced Preferences
Download Firefox for Desktop
New Tab to Right
Add Tab to New Group
Reload Tab
Mute Tab
Pin Tab
Duplicate Tab
Bookmark Tab...
Move Tab
Share
Select All Tabs
moz://a
Firefox Browser
Add Tab to New Group

FIREFOX

Organise tabs into themed groups

One of the most requested features for Firefox, which has long been available in Chromium browsers, is the ability to organise your tabs into groups. This prevents the browser from becoming cluttered with too many tabs, and lets you sort related web pages into themed groups.

Firefox 133, which was released on 26 November and will be the last new version of 2024, failed to add a tab-grouping option. But it does include an experimental hidden setting that lets you try an early version of the feature (see screenshot above) before it's officially introduced in 2025.

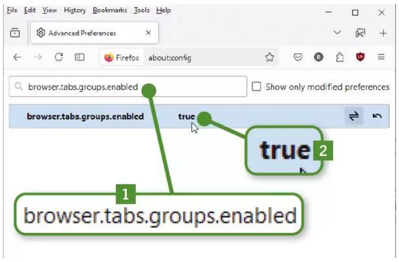
See our Workshop below to find out how to use Firefox's new Tab Groups option. Remember that it's still a work in progress, so is less polished than equivalent features in other browsers.

VIVALDI

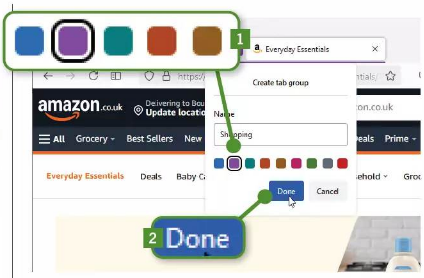
Add a weather widget to your Dashboard

There's a new Dashboard feature we've covered previously in Vivaldi 7, which you

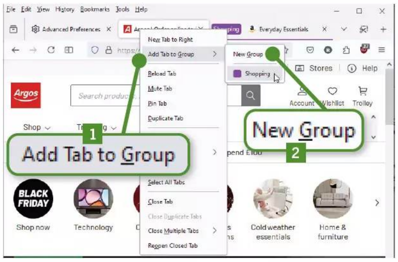
Workshop Try the new Tab Groups feature in Firefox


File Edit View History Bookmarks Tools Help
Advanced Preferences
Firefox about:config
browser.tabs.groups.enabled
Show only modified preferences
browser.tabs.groups.enabled true
true 2
1
browser.tabs.groups.enabled

Type about://config into the Firefox address bar, press Enter and click 'Accept the Risk and Continue'. Search for the preference browser.tab.groups.enabled 1, and double-click it to change its value from 'false' to 'true' 2.


1
Everyday Essentials
Create tab group
Name
Shopping
Done
Cancel
2 Done

This will activate the experimental Tab Groups feature in Firefox. Right-click a tab and you'll see a new 'Add Tab to New Group' option. Select this, give the tab group a suitable name and assign it a colour 1, then click Done 2.


File Edit View History Bookmarks Tools Help
Advanced Preferences
Everyday Essentials
New Tab to Right
Add Tab to Group
Reload Tab
Mute Tab
Pin Tab
Duplicate Tab
Select All Tabs
Close Tab
Close Duplicate Tabs
Close Multiple Tabs
Reopen Closed Tab
New Group
Shopping
1
Add Tab to Group
New Group
2

You can now add further tabs to the group by right-clicking them and choosing 'Add Tab to Group' 1 then the name of the group. Alternatively, select New Group 2 to create a new tab group with a different theme, name and colour.

Best extension for… Auto-filling data across devices

BITWARDEN PASSWORD MANAGER

Chromium
tinyurl.com/APC542bit
Firefox
tinyurl.com/APC542bitff

On 14 December, Microsoft retired its Autofill extension for Chrome. This automatically filled in your passwords, contact details and payment information on websites, and synced this data with the Microsoft Authenticator app on your phone or tablet.

Microsoft wants you to use the built-in Autofill in Edge instead, but if you'd prefer to stick with Chrome, you should consider switching to Bitwarden's extension. As well as securely storing your usernames and passwords, Bitwarden can be used to auto-fill payment-card details and personal information including your full name, phone number and address.

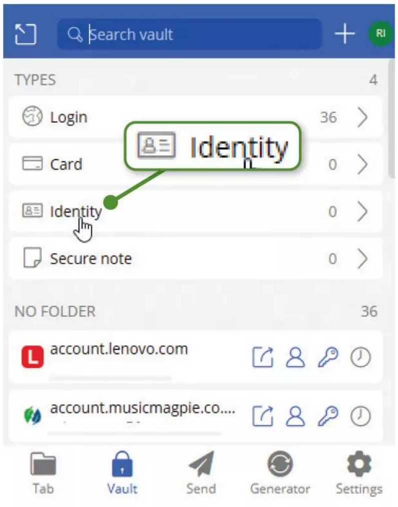
Click the Vault tab in the extension and select Identity (see screenshot) then 'Add item' to enter the details you want to save. Click a box on an online form and choose Bitwarden, then the relevant 'Auto-fill' option. Bitwarden also syncs your data with its free app for Android and iOS (**tinyurl.com/APC542bitmob**).

If you don't like that, try…

CHROME AUTO-FILL

chrome://settings/autofill

You can use Chrome's 'Autofill and passwords' feature to store passwords, contact info and payment-card details, and sync your data with the mobile browser.

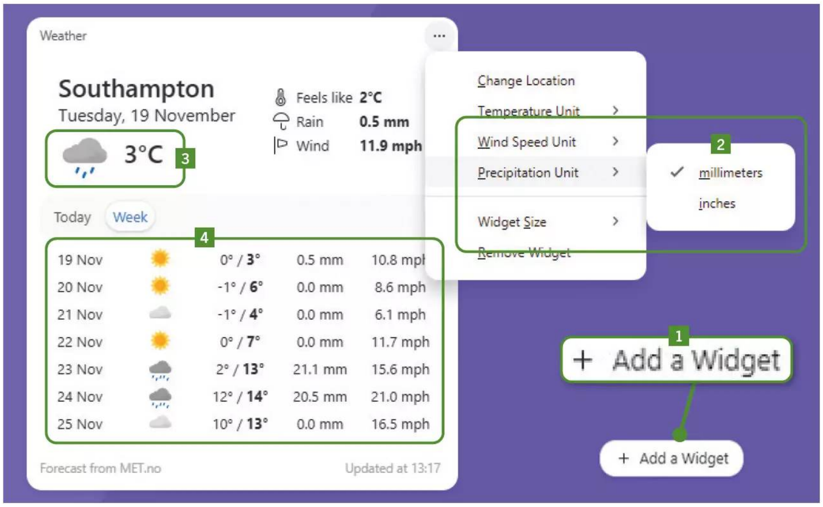

Search vault
RI
TYPES 4
Login 36
Card 0
Identity 0
Secure note 0
Identity
NO FOLDER 36
account.lenovo.com
account.musicmagpie.co....
Tab
Vault
Send
Generator
Settings

can customise using widgets. Vivaldi has now introduced a weather widget, which was its most- frequently requested Dashboard tool.

Click the 'Add a Widget' button at the bottom of your Vivaldi Dashboard (1 in our screenshot below right), and you should see the new Weather option in the strip of widgets that opens. Select it to add the Weather widget to the page, then search for and set your location. You can also specify whether to show the temperature in Celsius or Fahrenheit, the wind speed in miles or kilometres per hour, and precipitation (rain, snow etc) in millimetres or inches 2.

Click 'Done' and the Weather widget will provide a summary of the current weather conditions for your location 3 and a forecast for the next week 4. You can change your weather settings by clicking the three-dot icon in the top-right corner of the widget.

At the time of writing, the Weather widget was available in the latest Snapshot (preview) build of Vivaldi (**tinyurl.com/APC542viv**), but should be in the stable version of the browser by the time you read this.


Weather
...
Change Location
Temperature Unit
Wind Speed Unit
Precipitation Unit
Widget Size
Remove Widget
✓ millimeters
inches
Today
Week
1
2
3
4
+ Add a Widget
+ Add a Widget

Southampton
Tuesday, 19 November
3°C
Feels like 2°C
Rain 0.5 mm
Wind 11.9 mph

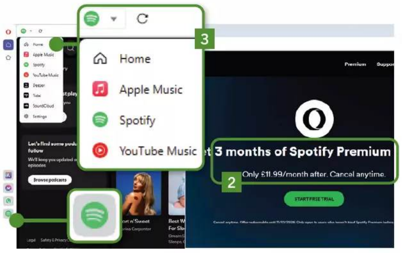
19 Nov	0° / 3°	0.5 mm	10.8 mph
20 Nov	-1° / 6°	0.0 mm	8.6 mph
21 Nov	-1° / 4°	0.0 mm	6.1 mph
22 Nov	0° / 7°	0.0 mm	11.7 mph
23 Nov	2° / 13°	21.1 mm	15.6 mph
24 Nov	12° / 14°	20.5 mm	21.0 mph
25 Nov	10° / 13°	0.0 mm	16.5 mph

Forecast from MET.no
Updated at 13:17

OPERA

Stream ad-free music with Spotify Premium

Opera now has lots of useful features other browsers lack. Its latest version, Opera One R2, has been updated to let you play free music and podcasts from Spotify without having to install an extension.

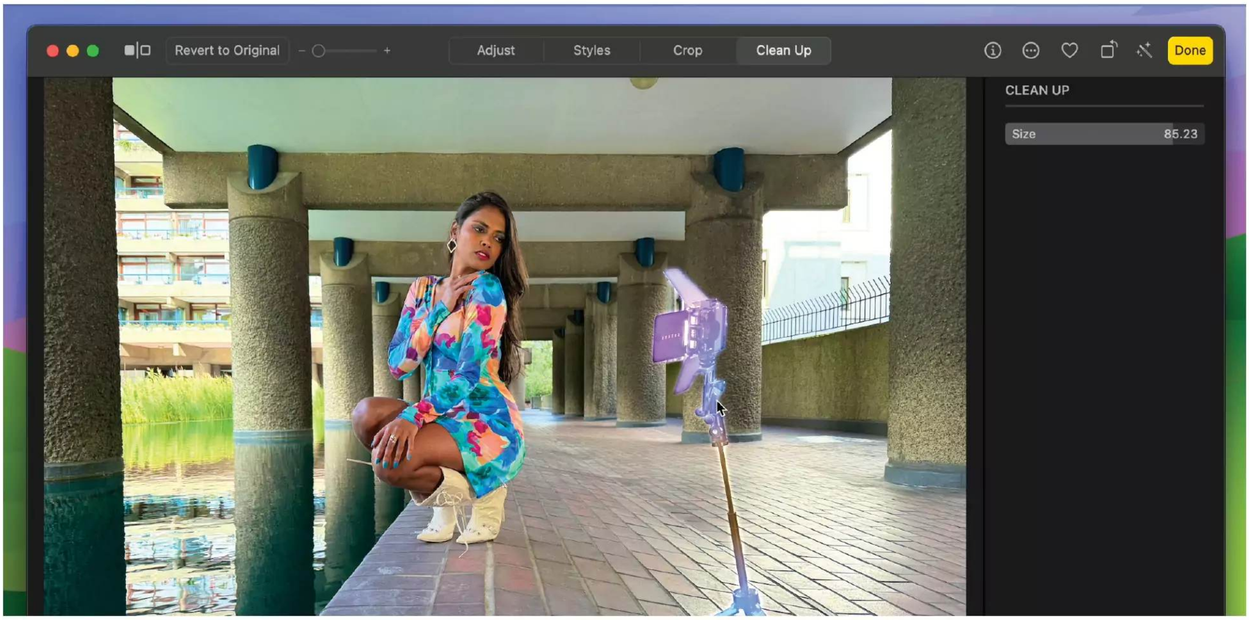

Home
Apple Music
Spotify
YouTube Music
3 months of Spotify Premium
Only £11.99/month after. Cancel anytime.
1
2
3

Spotify was already one of the streaming services available through Opera's built-in music player, along with Apple Music, YouTube Music, Deezer, Tidal and SoundCloud. It's now the default music option, which means the 'Player' button in the sidebar now bears the Spotify logo.

Opera says the new partnership is a "Scandinavian collaboration" between the Norwegian browser company and the Swedish streaming service (tinyurl.com/APC542opera1). What's more, the first time you click the new Spotify button (1 in our screenshot above), you'll be offered a free three-month subscription to Spotify Premium 2 – usual price $13.99 a month – to enjoy ad-free streaming in the browser.

You need to enter your payment-card details, but can cancel before the trial ends to avoid paying anything (it's not available to existing Spotify Premium subscribers).

The other music-streaming options are still available if you're not a Spotify fan. Just click the dropdown menu in the top-left corner of the Player panel 3 to switch to a different service. ■



Size 85.23

Clean up your photos

Use the new AI-powered Clean Up tool to remove unwanted objects.

IT WILL TAKE
15 minutes
YOU WILL LEARN
How to use Apple's Clean Up tool and access extensions
YOU'LL NEED
macOS 15.1 or later, Pixelmator Pro/ Adobe Photoshop optional

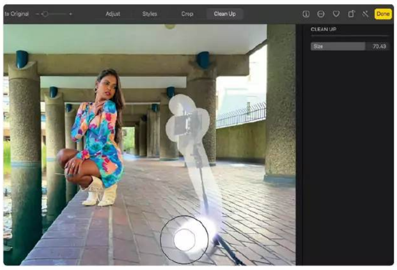
Apple Intelligence is finally here – and that means Photos now has added image-editing superpowers, thanks to the new AI-assisted Clean Up tool.

In older versions of Photos for Mac, you could try using the Retouch tool to replace unwanted spots or blemishes, but it struggled to remove larger objects without leaving smudged or blurry pixels. And there was no Retouch tool in the iOS version of Photos. The new AI-powered Clean Up tool does a much better job of replacing unwanted objects (such as a distracting background photo bomber) to create a cleaner shot. We're looking at Clean Up on the Mac and iPad here, but the tool is available in the iOS version of Photos too.

The Clean Up tool works amazingly well, but it can struggle on occasion. We'll show you how to access artificial intelligence (AI) tools from other apps from within Photos, so that you can call on an alternative AI resource, such as Pixelmator Pro ($79.99, **pixelmator.com/pro**) to help.

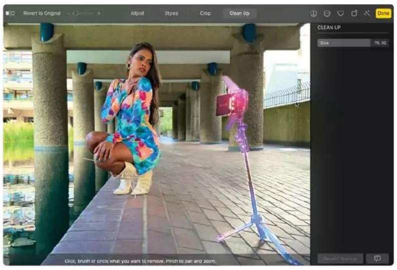
George Cairns ■

How to Use Clean Up on Mac



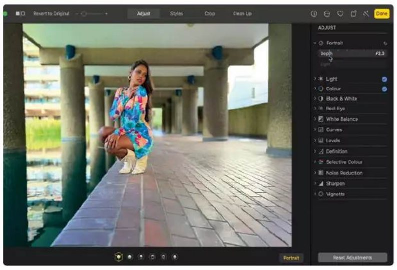
1 Access Clean Up

To remove unwanted objects click Edit. Click on the Clean Up button (or press Cmd+4 to access that workspace). In the Clean Up pane, drag the Size slider to choose a large brush tip. Spray the brush over the unwanted object.



2 Make a selection

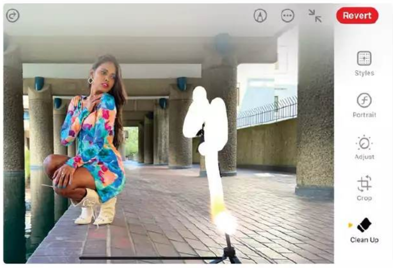
Your selection doesn't have to be very accurate. After you spray, Apple Intelligence analyses the unwanted object which glows with colours (like those around the edge of an iPhone's display when Siri is summoned).



3 Finishing touches

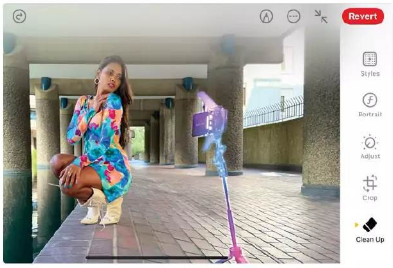
The Clean Up tool replaces the unwanted object with appropriate pixels. Spray again over any problem areas to fine-tune them. Use the Portrait Mode's Depth slider to blur the background. This helps hide retouched areas.

How to Use Clean Up on the move


Revert
Styles
Portrait
Adjust
Crop
Clean Up

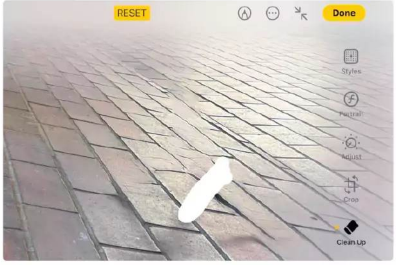
1 Make a selection

In Photos on iPhone or iPad, tap the Edit icon. Pinch to zoom in for a close look at the unwanted object. Tap the Clean Up tool. A 'Preparing Clean Up' message will appear. Scrub your finger over the unwanted object to target it.


Revert
Styles
Portrait
Adjust
Crop
Clean Up

2 AI analysis

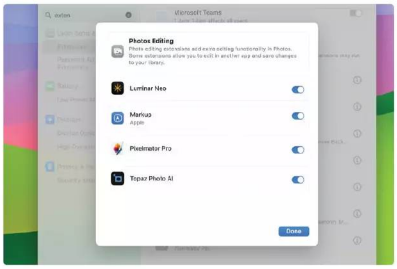
Even though you may have made a quick and rough selection, the Clean Up tool is clever enough to make the entire unwanted object glow as it analyses it. It will then replace the object with appropriate pixels to hide it.


RESET
Done
Styles
Portrait
Adjust
Crop
Clean Up

3 Tidy up

When an object overlaps complex details such as a tiled floor viewed in perspective, you may need to scribble over some remaining problem areas to get them to blend in with the surrounding architectural details.

How to Use third-party extensions on Mac



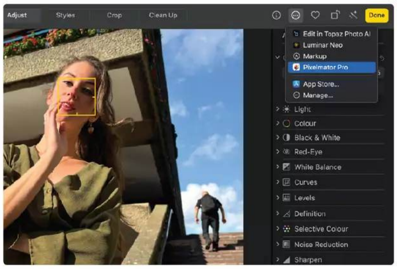
Photos Editing

Photo editing extensions add extra editing functionality in Photos. Some extensions allow you to edit in another app and save changes to your library.

Luminar Neo
Markup
Apple
Pixelmator Pro
Topaz Photo AI
Done
Microsoft Teams

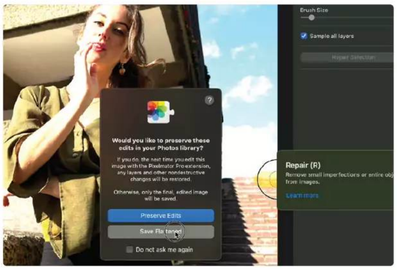
1 Add Extensions

If you have Pixelmator Pro, its AI tools are accessible from within Photos. Go to System Settings > Login Items & Extensions. In the Extensions pane's Photos Editing section, click the 'i'. Toggle on Pixelmator Pro.


Adjust
Styles
Crop
Clean Up
Done
Edit in Topaz Photo AI
Luminar Neo
Markup
Pixelmator Pro
App Store...
Manage...
Light
Colour
Black & White
Red-Eye
White Balance
Curves
Levels
Definition
Selective Colour
Noise Reduction
Sharpen

2 Access Pixelmator Pro

In Photos, click Edit. To remove an object or person, click the '…' and choose Pixelmator Pro. Your photo will appear in Pixelmator Pro's workspace. Select the Repair tool, then scribble over the object or person and their shadow.



Would you like to preserve these edits in your Photos library?

If you do, the next time you edit this image with the Pixelmator Pro extension, any layers and other nondestructive changes will be restored.

Otherwise, only the final, edited image will be saved.

☐ Do not ask me again

Repair (R)

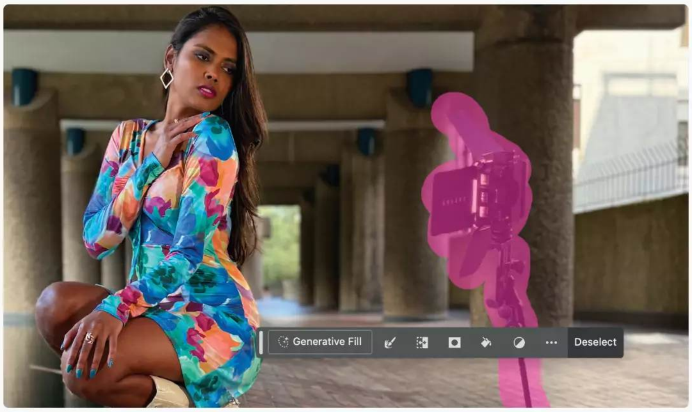
Remove small imperfections or entire obj from images.

☑ Sample all layers

Preserve Edits
Save Flattened
Brush Size
Repair Selection
Learn more

3 Save changes

The Repair tool will replace the unwanted object with suitable background pixels. You may need to spray a few times to tidy the area. Click Save Changes and save a flattened version of the edited shot in Photos.


Generative Fill
Deselect

Use other third-party apps

ACCESS APPS OUTSIDE OF PHOTOS EXTENSIONS

When dealing with more challenging clean-up operations, you might need the AI firepower of the Generative Fill tool in Adobe Photoshop.

Although Photoshop 2024 is not available as an extension in Photos, you can browse to a shot in Photos and choose Image > Edit With > Adobe Photoshop. With the shot open in Photoshop, scribble over the unwanted object with the Selection Brush tool, then click Generative Fill to remove it.

Saving private files

Shashank Sharma is a superhero whose superpower is rescuing deleted files. He has many useful tools in his utility belt, such as Rip2.

Deleting files is easy, and while rescuing them is possible, the process is quite involved and not foolproof. GUI users have the luxury of recovering files from the trash folder, but this isn't available for the CLI out of the box.

Written in Rust and released under the GPL3 licence, Rip2 is a replacement of the `rm` command. In the utility's terminology, all deleted files are sent to the graveyard, usually /tmp/graveyard-$USER, from where you can recover them with ease. This is distinct from the xdg-trash spec, which is what defines how files in the GUI are deleted and relegated to the trash folder.

You need Cargo, Rust's package manager, to install the latest release of Rip2, as the project isn't available in the software repositories of most popular desktop distros. The command `cargo install --locked rip2` will do the trick. You can run `brew install rip2` instead if your system is configured for Homebrew packages.

Easy delete

Depending on your distro configuration, the graveyard – the directory where deleted files are kept – may vary. Run `rip graveyard` to check the defined location:

```
$ rip graveyard
/tmp/graveyard-linuxlala
```

You can delete files with `rip dir dir2 filename`. Rip2 accepts a space-separated list of files and directories you wish to delete. Unlike `rm`, where you have to use the -r command switch to delete a populated directory, the `rip` command deletes a populated directory without asking for confirmation.

As we've mentioned, all deleted files and directory end up in the graveyard. You can undo the most recent delete operation with the `rip -u` command:

```
linuxlala@playground:~/Documents$ rip -u
Returned /tmp/graveyard-linuxlala/home/
linuxlala/Documents/test-dir~1 to /home/
linuxlala/Documents/test-dir
```

As you can see, the graveyard retains the absolute path for each deleted file and directory. This helps distinguish files with identical names, deleted from different parent directories. In the tool's parlance, the -u command option doesn't undo the deletion operation, but unburies the file.

Even more useful is Rip2's ability to resolve name conflicts. Consider that you delete a file uninspiringly named filename, and then delete it. Some time later, you create another file named filename, and delete that, too. Rip2 uses numbers to identify the latter files with the same name. Run the `rip -s` command for a list of all files deleted from the current working directory, along with their deletion time and path:

```
linuxlala@playground:~/Documents/test-dir$
ls
test  test-archive.7z  work-orders.pdf
work-orders.png
linuxlala@playground:~/Documents$ rip
test-dir/test
linuxlala@playground:~/Documents$ mkdir
test-dir/test
linuxlala@playground:~/Documents$ rip
test-dir/test
linuxlala@playground:~/Documents$ rip -s
deletion_time          path
2024-11-19T21:49:25              /tmp/
graveyard-linuxlala/home/linuxlala/
Documents/test-dir/test
2024-11-19T21:49:40              /tmp/
graveyard-linuxlala/home/linuxlala/
Documents/test-dir/test~1
```

While the `rip -u:` command can be used to undo the last delete operation, you can instead run `rip 2 -u <graveyard-path>` to restore a specific file:

```
$ rip -u /tmp/graveyard-linuxlala/home/
linuxlala/Documents/HPG
Returned /tmp/graveyard-linuxlala/home/
linuxlala/Documents/HPG to /home/linuxlala/
Documents/HPG
```

> "You need Cargo, Rust's package manager, to install the latest release of Rip2, as the project isn't available in the software repositories of most popular desktop distros."

To restore all the files and directories deleted from the current directory, you can combine the -s and -u command options, and run the `rip -su` command.

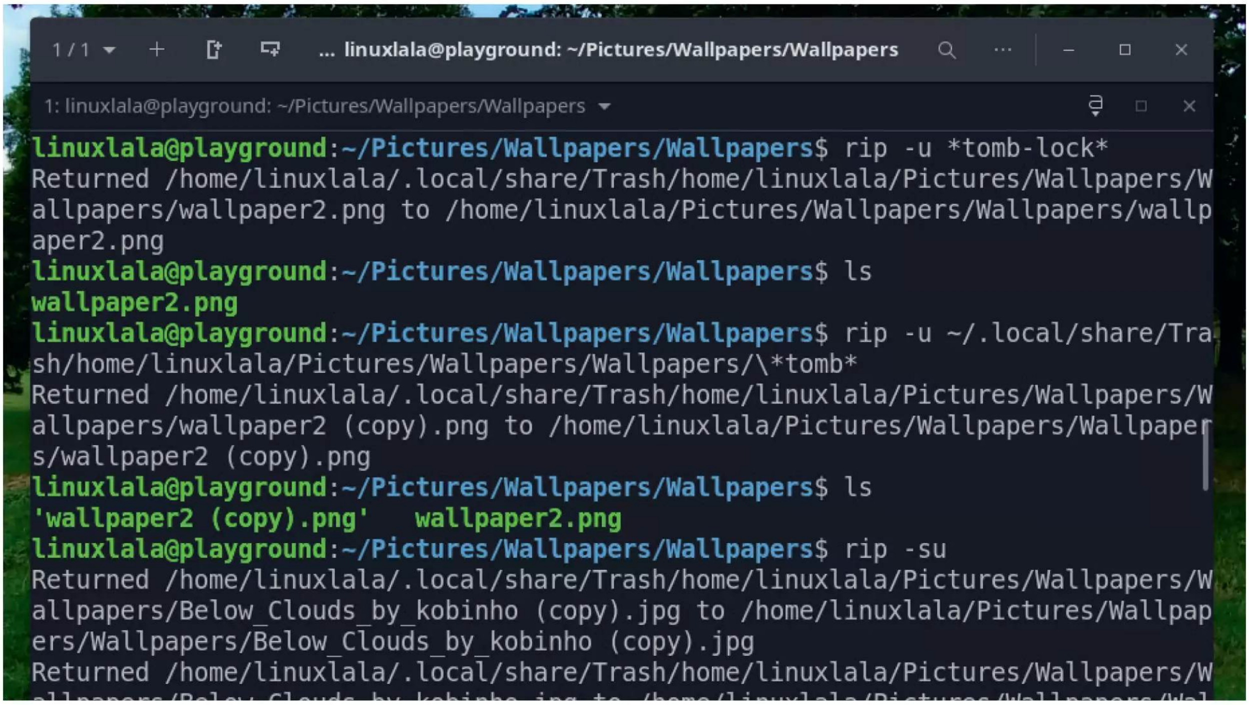
Although you can run the `rip -h` command for a quick introduction to the command options, we'll list the most useful ones here:

Option	Function
-i, --inspect	Print info about the specified file before deletion
-u, --unbury	Restore the specified file/directory
-s, --seance	List all files and directories deleted from current working directory
-d, --decompose	Permanently delete the graveyard

If you would prefer the deletion tool to ask for confirmation before sending the specified file or directory to the graveyard, you would have to invoke `rip` with the -i command option. This prints the size of the file or directory, and the first few lines of the file for your perusal, then asks for confirmation before sending them to the graveyard. The -i option prints the first few lines of a text file, but offers little more than file size for other file formats, such as PDF or PNG:

```
$ rip -i work-orders.png
work-orders.png: file, 73.5 KiB
> �
Send work-orders.png to the graveyard? (y/N)
N
$ rip -i work-orders.pdf
work-orders.pdf: file, 11.6 MiB
> %PDF-1.7
> 4 0 obj
> << /Length 5 0 R
>   /Filter /FlateDecode
Send work-orders.pdf to the graveyard? (y/N)
N
$ rip -i testfile.txt
testfile.txt: file, 99 B
> This is a text file. The Rip2 utility doesn't
raise any alarms about deleting non-empty
directories.
Send testfile.txt to the graveyard? (y/N)
```

You can also use -i to inspect directories before relegating them to the graveyard. Rip2 doesn't list the contents of subdirectories, or points out that the directory to be deleted has non-empty subdirectories:


1 / 1
... linuxlala@playground: ~/Pictures/Wallpapers/Wallpapers
1: linuxlala@playground: ~/Pictures/Wallpapers/Wallpapers

```
linuxlala@playground:~/Pictures/Wallpapers/Wallpapers$ rip -u *tomb-lock*
Returned /home/linuxlala/.local/share/Trash/home/linuxlala/Pictures/Wallpapers/W
allpapers/wallpaper2.png to /home/linuxlala/Pictures/Wallpapers/Wallpapers/wallp
aper2.png
linuxlala@playground:~/Pictures/Wallpapers/Wallpapers$ ls
wallpaper2.png
linuxlala@playground:~/Pictures/Wallpapers/Wallpapers$ rip -u ~/.local/share/Tra
sh/home/linuxlala/Pictures/Wallpapers/Wallpapers/\*tomb*
Returned /home/linuxlala/.local/share/Trash/home/linuxlala/Pictures/Wallpapers/W
allpapers/wallpaper2 (copy).png to /home/linuxlala/Pictures/Wallpapers/Wallpaper
s/wallpaper2 (copy).png
linuxlala@playground:~/Pictures/Wallpapers/Wallpapers$ ls
'wallpaper2 (copy).png'   wallpaper2.png
linuxlala@playground:~/Pictures/Wallpapers/Wallpapers$ rip -su
Returned /home/linuxlala/.local/share/Trash/home/linuxlala/Pictures/Wallpapers/W
allpapers/Below_Clouds_by_kobinho (copy).jpg to /home/linuxlala/Pictures/Wallpap
ers/Wallpapers/Below_Clouds_by_kobinho (copy).jpg
Returned /home/linuxlala/.local/share/Trash/home/linuxlala/Pictures/Wallpapers/W
```

You can't use regex to specify the files to restore and must manually enter the name with the 'rip -u <path>' command to restore it.

```
$ rip -i test-dir/
test-dir/: directory, 13.0 MiB including:
/home/linuxlala/Documents/test-dir/test
/home/linuxlala/Documents/test-dir/test-archive.7z
/home/linuxlala/Documents/test-dir/test~1
/home/linuxlala/Documents/test-dir/work-orders.pdf
/home/linuxlala/Documents/test-dir/work-orders.png
Send test-dir/ to the graveyard? (y/N) N
```

The `rip -d` command can be run to completely delete all files from the graveyard. Once you do that, it wouldn't be possible to restore and files.

Caveat emptor

The phrase caveat emptor implies that the buyer alone is responsible for checking the goods or property. This is quite apt in the context of Rip2, since it places deleted files and directories in the /tmp directory. Conventionally, the /tmp directory is considered unsafe from a security point of view, as it's world-readable.

That said, Rip2 retains the file permissions of the original files and directories when placing them in the graveyard. Even so, it is wise to consider changing the location of the graveyard, for added security.

```
linuxlala@playground:~$ cd /tmp/graveyard-linuxlala/test-dir~1
linuxlala@playground:/tmp/graveyard-linuxlala/test-dir~1$ ls -l
total 13340
drwxrwxr-x 2 linuxlala linuxlala 4096 Nov 19 21:49 test
drwxrwxr-x 3 linuxlala linuxlala 4096 Nov 19 21:20 test~1
-rw-r--r-- 1 linuxlala linuxlala  1359220 Nov 19 21:16 test-archive.7z
-rw-rw-r-- 1 linuxlala linuxlala 12213836 Nov 19 21:16 work-orders.pdf
-rw-rw-r-- 1 linuxlala linuxlala   75260 Nov 19 21:16 work-orders.png
```

Per the project's GitHub page, you can use the alias command to change the location of the graveyard. Run the `alias rip='rip --graveyard ~/.local/share/Trash'` command to change the location of the graveyard.

```
$ alias rip='rip --graveyard ~/.local/share/Trash'
$ touch testfile
$ rip testfile
$ rip -s
deletion_time          path
2024-11-19T22:28:01          /home/linuxlala/.local/share/Trash/home/linuxlala/testfile
```

We don't usually feature very fresh utilities, but the functionality offered by Rip2 can not be overstated. All told, the Rip2 utility is fairly easy to master and work with. We're especially fond of how it resolves name conflicts as it retains the ~<number> naming convention when you restore files and directories. ■

FETCH SYSTEM INFORMATION

In the early days of Linux, you had to run `cat /proc/cpuinfo` to fetch information about the CPU; `cat /proc/meminfo` similarly printed details about your RAM. There were still other commands you needed to remember and run to check the OS version you had installed, the version of the kernel, and so on.

Nowadays, there are many system information-retrieving tools that provide all these details and more. Neofetch was one of the most popular, but it has not seen a new release in over four years. We now prefer Fastfetch. Written mostly in C, and released under the MIT Licence, Fastfetch is available in the software repositories of most popular desktop distros, such as OpenSUSE, Debian, Fedora, Arch and others. If you're running Ubuntu 22.04 or newer, you have to enable the Fastfetch PPA with `sudo add-apt-repository ppa:zhangsongcui3371/fastfetch` before you can install it with the `sudo apt install fastfetch` command.

When you run Fastfetch, it generates ASCII art of your distro's logo, and also prints information such as OS, host device, kernel, uptime, shell, memory, swap and various other details.

Phone & tablet tips

Brilliant things to do on your device.

ANDROID & iOS

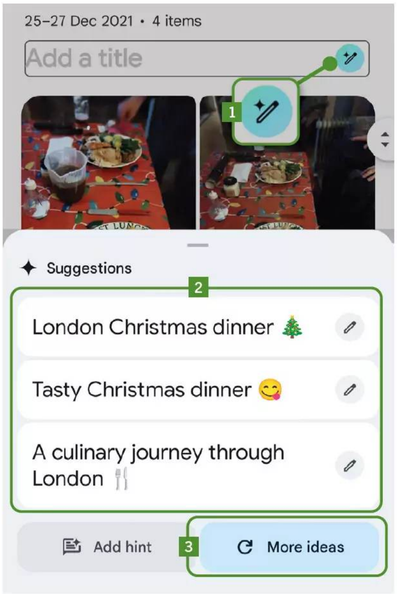
Use AI to generate titles in Google Photos

Google Photos has added an AI feature that suggests titles for your 'memories' in the app. This is useful when you can't decide what to call a set of photos from a particular day, to make the memory easier to find and share.

To try the new AI tool, press the Memories tab at the bottom of the Google Photos app, then tap 'Help me title' next to a memory. Alternatively, tap 'Add a title' and press the glowing pencil icon (1 in our screenshot below left).

Select 'See suggestions' and Google Photos will use AI to analyse the content of the pictures and generate three appropriate titles 2. Press your favourite suggestion to apply it to the memory, or tap the Edit button to change a word or two. You can also tap 'Add hint' to specify a detail to include in the title, or choose 'More ideas' 3 to generate a new set of suggestions.

Once you've tried the AI feature, Google Photos should automatically suggest titles below the 'Add a title' box of all your memories. If you can't get the option to work, tap your profile icon in the top-right corner of the app and select 'Google Photos settings' then Preferences. Press 'AI features by Labs' and switch on the 'Help me title' setting.


25–27 Dec 2021 • 4 items

Add a title

Suggestions

London Christmas dinner 🎄

Tasty Christmas dinner 😋

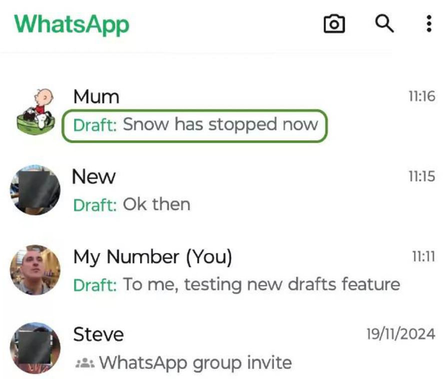
A culinary journey through London 🍴

ANDROID & iOS

Save drafts of your WhatsApp messages

WhatsApp has introduced a handy 'message drafts' feature, which automatically saves what you type. This highlights messages you started writing, but never finished or forgot to send, and stores them on your Chats tab so you can pick up where you left off.

When you exit a chat without sending the message you typed, it will be moved to the top of your Chats list and highlighted with a green 'Draft:' label (see screenshot above) so it's easy to spot. You can then either finish and send the message, or delete the draft and not bother. On the downside, you'll no longer be able to use the excuse of writing a reply but forgetting to press Send.



Mum 11:16
Draft: Snow has stopped now

New 11:15
Draft: Ok then

My Number (You) 11:11
Draft: To me, testing new drafts feature

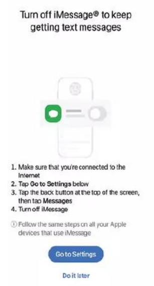
Steve 19/11/2024
WhatsApp group invite

iOS

Reduce travel sickness in moving vehicles

One of the lesser-known but undoubtedly useful new features in iOS

Best new apps What you should install this month


Turn off iMessage® to keep getting text messages

1. Make sure that you're connected to the Internet
2. Tap **Go to Settings** below
3. Tap the back button at the top of the screen, then tap **Messages**
4. Turn off iMessage

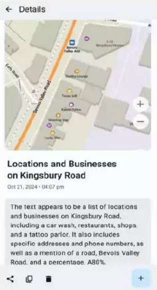
ⓘ Follow the same steps on all your Apple devices that use iMessage

ANDROID SWITCH

Free

iOS tinyurl.com/APC542switch

Google has renamed and redesigned its app for switching from an iPhone or iPad to an Android phone or tablet. Formerly called 'Switch to Android', it helps you move your contacts, photos and videos, and swap iMessage for RCS/SMS messages. The updated app has a streamlined interface and simpler wording.



Locations and Businesses on Kingsbury Road
Oct 21, 2024 • 04:07 pm

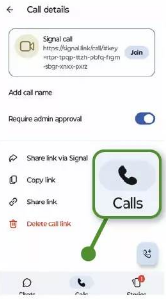
The text appears to be a list of locations and businesses on Kingsbury Road, including a car wash, restaurants, shops and a tattoo parlor. It also includes specific addresses and phone numbers, as well as a mention of a road, Bevois Valley Road, and a percentage, A80%.

PIXELSHOT

Free

Android tinyurl.com/APC542pixel

PixelShot brings features from the Screenshots app on Google Pixel 9 phones to other Android devices. It uses AI to summarise the contents of your screenshots, so you can quickly find specific images by searching for keywords. The app also lets you add notes to organise screenshots and sort them into themed collections.



https://signal.link/call/#key=rtpr-tpqp-ttzh-pbfq-frgm-sbgr-xnxx-pxrz

SIGNAL

Free

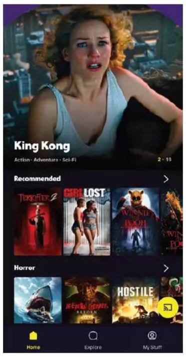
Android tinyurl.com/APC542sig

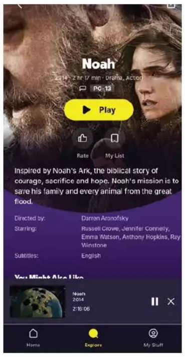
iOS tinyurl.com/APC542sigio

This popular messaging app has added a Calls tab, which makes it easier to start group video calls. Tap the new tab, select 'Create a Call Link' and share the link with up to 50 people you want to chat to, then press 'Join' to start the video call. Signal also now lets you use emoji reactions and a raise-hand button in chats.

*Contains in-app purchases

Best apps for... Streaming free films


King Kong
Action · Adventure · Sci-Fi
Recommended
Horror
Home
Explore
My Stuff


Noah
2014 · 2 hr 17 min · Drama, Action
PG-13
Play
Rate
My List
Noah
2014
2:16:06
Home
Explore
My Stuff

Inspired by Noah's Ark, the biblical story of courage, sacrifice and hope. Noah's mission is to save his family and every animal from the great flood.

Directed by: Darren Aronofsky
Starring: Russell Crowe, Jennifer Connelly, Emma Watson, Anthony Hopkins, Ray Winstone
Subtitles: English

TUBI

Free

Android https://tinyurl.com/APC542tubi

iOS tinyurl.com/APC542tubio

While many streaming services upped their prices in 2024, Tubi launched with a huge catalogue of free films. Notable titles include the 2006 remake of *King Kong*, biblical epic *Noah* and *Ali* starring Will Smith as the titular boxer. You don't even need to register to stream its free, ad-supported content.

Best For: Free Hollywood films

pluto
Sign In
Movies
Bingeable Drama
True Crime
British Movies
British Movies
41 Titles
Classics
B Movies
B Movies
60 Titles
Erik The Viking
Comedy
Home
Live TV
On Demand
Search

Erik The Viking
Rated 12+ • 2h 1min • Comedy
Watch Now
Watch List
Share
You May Also Like
Erik The Viking
Comedy

Erik the Viking and his men travel across the sea to find Valhalla to ask the gods to end the Age of Ragnarok.

PLUTO TV

Free

Android tinyurl.com/APC542plu

iOS tinyurl.com/APC542pluio

Tap the Movies tab in Pluto TV's On Demand section to browse and stream thousands of free films. These are organised into helpful categories such as Disaster Movies, Comedy, Sci-Fi and Westerns, and can be watched on your phone or tablet with a single tap. Pluto also has a dozen 'live' (meaning scheduled) movie channels.

Best For: Eclectic choice of films

Films
Featured ›
Film - Family
Paddington
Film - Period
Jude
Award Winners & Nominees ›
Film - Romance
Atonement
Film - Rom-Com
Four Weddings and a Funeral
Horror & Suspense ›
Home
Explore
Watchlist
Downloads

ONE
Paddington
85 mins 2014 Available for 1 month
Start watching
Watchlist
Share
Download
More Like This
Home
Explore
Watchlist
Downloads

Finding himself lost and alone at Paddington station, a young Peruvian bear is befriended by the Brown family and attempts to find an explorer who visited Peru many years earlier.

BBC IPLAYER

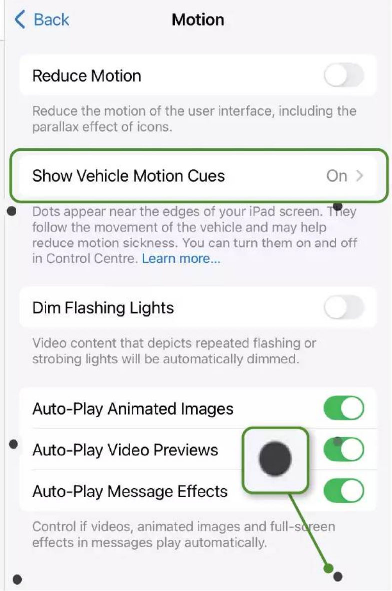
Free

Android tinyurl.com/APC542bbc

iOS tinyurl.com/APC542bbcio

Many people forget that, in addition to TV shows, BBC iPlayer has an impressive selection of films you can watch for free. These are regularly updated and currently include *Paddington*, *Citizen Kane*, *The Third Man* and the original *King Kong*. Most can be downloaded to your mobile device to watch offline.

Best For: Classic and British films



‹ Back Motion

Reduce Motion ○

Reduce the motion of the user interface, including the parallax effect of icons.

Show Vehicle Motion Cues On ›

Dots appear near the edges of your iPad screen. They follow the movement of the vehicle and may help reduce motion sickness. You can turn them on and off in Control Centre. Learn more...

Dim Flashing Lights ○

Video content that depicts repeated flashing or strobing lights will be automatically dimmed.

Auto-Play Animated Images ●

Auto-Play Video Previews ●

Auto-Play Message Effects ●

Control if videos, animated images and full-screen effects in messages play automatically.

18 is designed to alleviate travel sickness when you're using your iPhone or iPad in a moving vehicle. Many car passengers experience motion-related nausea while trying to read on journeys, because the movement of the vehicle transmits different signals to your brain from what your eyes are seeing.

The usual advice for reducing travel sickness is to stop reading and stare straight ahead at a fixed point, but in iOS 18 you can try a different solution called Vehicle Motion Cues. This uses sensors in your device to detect vehicle movement and displays animated dots on the edges of your screen that match your direction of travel. These black dots don't interfere with what you're doing, but help your brain align what it feels with what it sees, and potentially take the edge off your nausea.

To activate this new feature on your iPhone or iPad, open the Settings app and select Accessibility then Motion. Press 'Show Vehicle Motion Cues' (1 in our screenshot above) and switch on the option. Black dots 2 will now appear on the edges of your screen and move in tandem with the car, bus or other vehicle you're travelling in. You can turn them off and on again via the Control Centre.

ANDROID

Get reminders to take a screen break

It's easy to become so engrossed in watching YouTube videos, browsing social media or doomscrolling news stories that you can lose track of time, and strain your eyes in the process.

To stop this happening, Google has introduced a feature called Screen Time Reminders, which gently notifies you when you're spending too long in a particular app.

The new option is part of the Digital Wellbeing Suite on Android phones and tablets – though not on Samsung Galaxy devices, which have their own Digital Wellbeing features. To turn it on, open the Settings app, then swipe down to and press 'Digital Wellbeing and parental controls'.

Swipe down on this screen to find and switch on the new 'Screen time reminders' setting (see screenshot left) and choose (by ticking their boxes) which apps you want to see 'gentle reminders' for after you've spent a long time viewing them.

Google doesn't specify what it considers to be a long time, but we've seen reminders after 25 minutes. These appear in small bubbles at the top of the app, saying 'Used for [length of time]', which you can swipe off-screen to ignore. ■

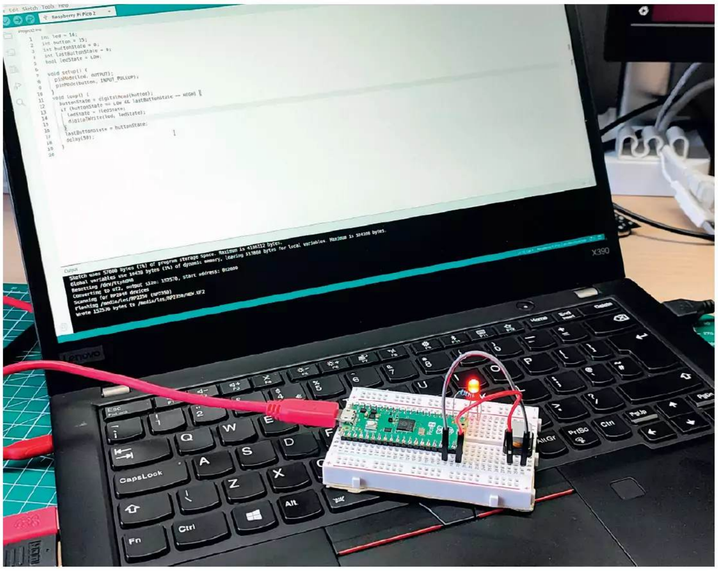
*Contains in-app purchases

Bringing Arduino IDE coding to the Pi Pico

Les Pounder loves a blinking LED – it probably take him back to the flashing clock on his old VCR he could never reset…

YOU'LL NEED

- Pi Pico, Pico W or Pico 2
- 1x 100 ohm resistor (brown-black-brown-gold)
- 1x breadboard
- 4x M2M jumper wires
- 1x LED
- Get the code: **https://bit.ly/lxf323code**



Yes that is a Pi Pico 2 running code written in the Arduino IDE.

The Arduino IDE is a popular choice for makers who work with microcontrollers. It writes code that is compiled and written for fast execution on the target microcontroller. But do we really need to spend big money on an Arduino? No! A $6 Raspberry Pi Pico or the new $13 Pico 2 also works thanks to a great piece of software from Earle F Philhower III (https://github.com/earlephilhower/arduino-pico), which makes it easy to write Arduino code on the Pico.

Hello Arduino

Earle F Philhower, III's Arduino Core works with the Arduino IDE to bring compatibility to the Raspberry Pi Pico's RP2040 and the Raspberry Pi Pico 2's RP2350. So, how do we get started?

First we need to install the Arduino IDE. This can be via your package manager or via the ZIP archive or AppImage file. We used the AppImage from the Arduino website (**www.arduino.cc/en/software**), which required us to make the downloaded file executable (right click > Properties > Permissions > Executable As A Program). Before we can use the Arduino IDE, we need to add our user to a group called dialout, which can access the serial ports. Open a terminal and run the following (change <username> to your username):

```
$ sudo usermod -a -G dialout <username>
```

Reboot the OS and when ready double-click on the Arduino AppImage file to launch. The launch takes a few seconds to start, so be patient.

In the Arduino IDE, we now need to add the Pico boards. Go to File > Preferences and in the new dialog look for Additional Boards Manager URLs. Click on the window icon to the right and a new dialog appears. Paste the following on a new line.

```
https://github.com/earlephilhower/arduino-pico/releases/download/global/package_rp2040_index.json
```

Click OK twice to close both dialogs. Now go to Tools > Boards > Boards Manager and search for Pico. Look for Raspberry Pi Pico/RP2040/RP2350 and select Install. This may take a while but the serial monitor window tells you when it is done.

Arduino LEDs

The circuit for this part of the project is a simple LED connected to GPIO 16 on the Pico. The long leg (anode) connects to GPIO16, the short leg connects to any GND pin via a 100 ohm resistor (brown-black-brown-gold). See the high resolution diagram in the download.

We are now ready to take our first steps with writing Arduino code for the Pico. Click on File > New Sketch to create a new blank project file (aka a sketch). The sketch has two sections. The first is setup(), and here we write code that happens when the Arduino/Pico is powered up. In loop() we write code that will repeat.

Let's start by adding a new line above `void setup()`. This line creates a variable, and with the Arduino language we need to specify what type of data the variable will store. In this case it is an integer, a number. The variable name is led and we assign the value of 16 to it. GPIO 16 is the GPIO that we will use with the LED.

```
int led = 16;
```

Now let's set up the sketch. We use the variable to set up pin 16 as an output and then start a serial connection at 115,200b/s. The serial connection is used to send output to the serial monitor.

```
void setup() {
  pinMode(led, OUTPUT);
  Serial.begin(115200);
}
```

Our focus shifts to the loop(). Here is where the main body of code will run. First, the loop will use digitalWrite to set the GPIO pin for our LED (16) to HIGH (on). Then we print a message to the serial monitor to tell us that. Why? For debugging! It shows that the code is running, so if we have an issue, we can check our wiring. We then add a short delay. Arduino uses milliseconds, so 100ms is 1/10 of a second.

```
void loop() {
  digitalWrite(led, HIGH);
  Serial.println(“LED ON”);
  delay(100);
```

The next section of code inside the loop handles turning the LED off but setting the GPIO pin to LOW (off), printing a message to the serial monitor, then pausing for another 1/10 of a second. Then the loop is closed using }. If we forget to add that, the Arduino IDE will tell us when we compile the code.

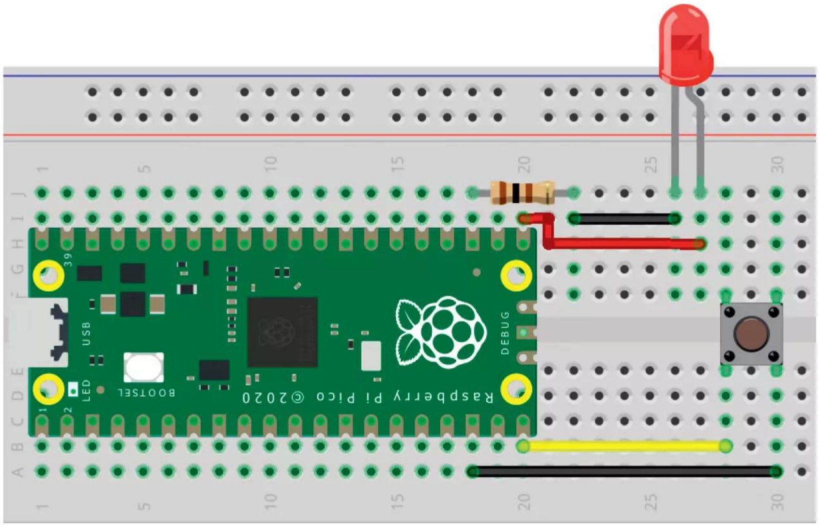
```
  digitalWrite(led, LOW);
  Serial.println(“LED OFF”);
  delay(100);
}
```

Save the code as project1. The next step is to connect our Pico to the computer. Connect the USB cable to the computer, then press and hold BOOTSEL on the Pico as you insert the micro USB end of the cable into the Pico. This forces the Pico to start in Bootloader mode, where it expects a firmware image to be written. Click on Tools > Board > Raspberry Pi Pico/RP2040/RP2350 and select Raspberry Pi Pico/Pico W/Pico 2 according to which board you are using. Under the Tools menu, you will see a drop-down with the USB logo. This should now read Raspberry Pi Pico, and clicking on it shows the serial port in use.

To check our code is correct, click on the tick icon in the top-left. This compiles and checks that our code will cleanly build. If you see any red text in the output, check the error message. If all is good, click on the right-pointing arrow icon next to the tick. This compiles and uploads the code to the Raspberry Pi Pico. The first time takes a little longer, as the Arduino Core is flashing some firmware to make the board work. In a few seconds the LED will blink to life! Click on Tools > Serial Monitor to see the output. You've done it!

Arduino I/O

Let's do something a little more complex. A push button-controlled LED. The circuit diagram for this is also in the downloads, but we're essentially just adding a button to the existing circuit.



The circuit for project 2 is simply an extension of project 1. We're just adding the button.

Create a new sketch, and start the code by creating variables to store integer values for the LED pin, button pin and the current button state and the last button state. A variable with a Boolean value is used for the LED state:

```
int led = 16;
int button = 15;
int buttonState = 0;
int lastButtonState = 0;
bool ledState = LOW;
```

On to the setup() and we configure the LED as an output, but the button is an input, and its GPIO pin, 15, has an internal resistor that we use to pull the pin high. The other side of the button is connected to GND, so when the button is pressed, the state changes from HIGH to LOW, triggering an action:

```
void setup() {
  pinMode(led, OUTPUT);
  pinMode(button, INPUT_PULLUP);
}
```

The loop reads the button pin and stores the value in buttonState:

```
void loop() {
  buttonState = digitalRead(button);
```

An if conditional check reads the value in buttonState and if it is LOW and the lastbuttonState is HIGH, it toggles the value of ledState between HIGH and LOW. The value of ledState is used to toggle the LED on and off:

```
  if (buttonState == LOW &&
lastButtonState == HIGH) {
    ledState = !ledState;
    digitalWrite(led, ledState);
  }
```

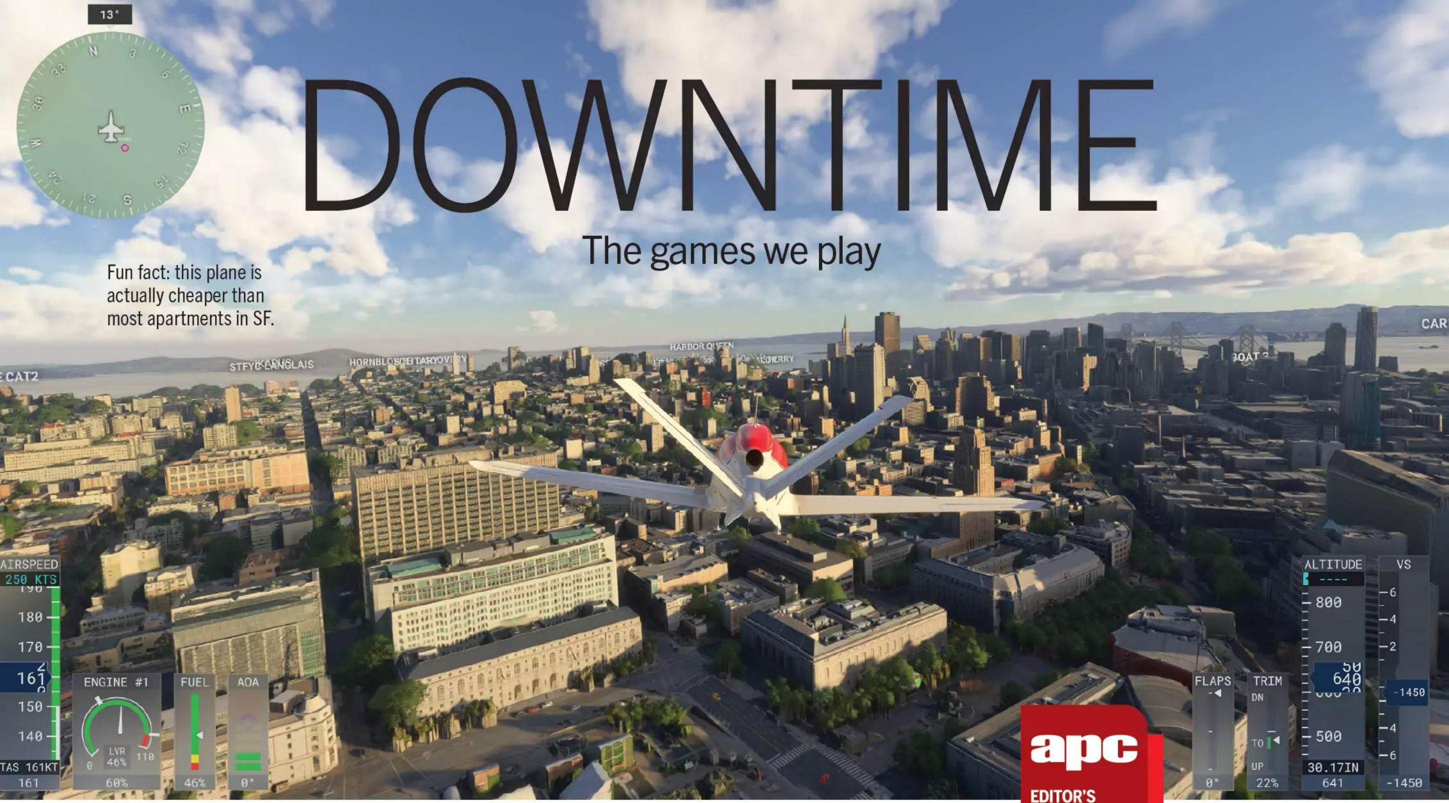
The current button state is then stored in the lastButtonState, ready for the loop to repeat. The final line is a short delay used to stop accidental keypresses.

Save the sketch as project2 and then compile (tick) and upload (right arrow) the code to the Pico. Wait for a few seconds, and nothing happens! Press the button to toggle the LED on and off. ■

BLINKING LEDS!

Hello, world! This phrase is the first thing that we do when learning to code. No matter the language, we do just that. In Basic, we use `PRINT “Hello World”`, and in Python, `print(“Hello, world”)`, but how do we do it with electronics? For that we need the humble LED, a simple output device that provides the instant feedback we need to develop, and the buzz of success when we see it. The generally accepted way to describe the Hello World with an LED is Blink.

Why do we need a Blink? Learning to code with an Arduino, Pi, ESP32 and so on means we need to learn the language and the hardware. We will make a mistake, so we start simple, learning how to turn a GPIO pin on/off and showing the output with an LED. No messy configurations, just two states (on/off) and a few lines of code. We added a serial print line for debugging. If we see the serial message, we know the code is running. If the LED doesn't blink, is it wired up correctly? Are the legs the wrong way round? Is the resistor in place? If those are correct, we need to check the GPIO pin in the code. Did we write 16 or 15/17? Yeah, we wrote 17 the first time.



DOWNTIME

The games we play

Fun fact: this plane is actually cheaper than most apartments in SF.

apc EDITOR'S CHOICE

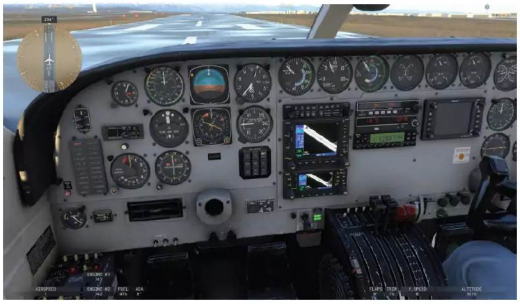
PRICE $109.95 **PLATFORM** PC, **WEB** flightsimulator.com

Microsoft Flight Simulator 2024

Higher, further and faster.

Presenting the entire Earth in even greater fidelity than its 2020 predecessor, it's hard to overstate what a remarkable technical accomplishment *Microsoft Flight Simulator 2024* represents. The aircraft and cockpits are astoundingly detailed, both visually and in how they function. The physics of flight are delightfully authentic, and while it has its quirks, no one has ever even tried to include our entire planet in a game with such fine-grain detail.

Microsoft has identified three types of players *Flight Simulator* aims to cater to: hardcore simmers who want the most realistic experience, gamers who want to earn rewards for completing challenges, and sightseers who want to visit cool world landmarks. While I'd say the simmers and sight-seers are well served, *FS2024*'s attempt at a goal-driven career mode is a little bit underwhelming. I did enjoy practising and taking exams to earn new certifications for stuff like IFR flight and jet aircraft, but the actual economics of being a freelance pilot are shallow and not that interesting to manage.



It hardly mattered when I was cruising in and out of gorgeous volumetric clouds or diving down almost low enough to dip my toes in the sparkling Nile, however. *FS2024* truly looks incredible. At least from 1,000 feet up, or when you're admiring the many bespoke airports and landmarks – both new and returning from *FS2020* – it's probably one of the best-looking games I've ever played.

Aside from a good internet connection and a good GPU, the remaining entry cost to have an ideal experience with *FS2024* is some kind of a dedicated peripheral. You don't have to splurge on a full HOTAS if you don't want to – my trusty Logitech Extreme 3D Pro, which will run you about $30 on sale, served perfectly admirably with a keyboard beside it to give me access to more hotkeys.

If you're less interested in the simulation aspects, there are a lot of options to tweak your flying experience. With all of the assists turned on, it can feel pretty arcadey, much too arcadey for my taste. On the other end of the spectrum, you can go through a pre-flight checklist and manually flip every switch in the cockpit before takeoff, and the air traffic control system is much more detailed than *FS2020*. You're still going to hear a lot of uncanny AI voices, which I don't love. But given the number of missions and different airports, it's not like they could have recorded human dialogue for all of it.

Flight Simulator 2024 takes the mind-boggling ambition of the 2020 sim and executes on it even better. Some of the new things it tries to do work better than others, but the core of what makes this long-running franchise great is stronger than ever.

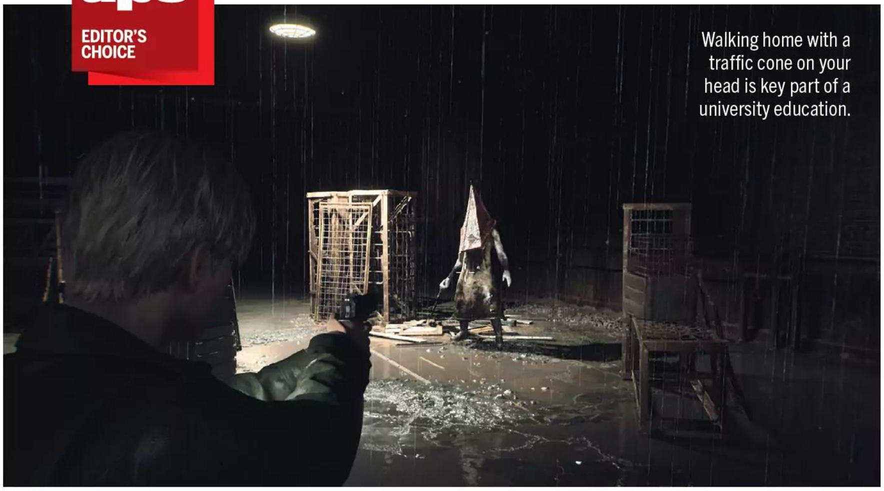
VERDICT

★★★★½

Microsoft Flight Simulator 2024 fulfills the promise of being the most true-to-life and detailed game of its kind.

Len Hafer

apc
EDITOR'S CHOICE


Walking home with a traffic cone on your head is key part of a university education.

PRICE $102.50 **PLATFORM** PC, PS5 **WEB** tinyurl.com/APC542hill

Silent Hill 2

This remake shines and stumbles in equal measure.

This modern remake of that legendary tale gets off to a great start, offering an extensive range of graphical settings and accessibility options. It doesn't take long to tweak the game into a smoothly running ray-traced beauty, or to adjust the controls and their behaviour so they're just the way I like them.

Those horrors look impressively familiar, even decades removed from the game's PlayStation 2 debut. The rust-covered hellscapes, the signage, the glistening sacks of flesh scuttling past locked-up homes tumbling into the abyss – it's easy to believe *Silent Hill 2* always looked this good, but that illusion takes a lot of hard work.

The remake's treatment of the series' signature fog is just as remarkable. It seems to roll over the scenery, pool in dirty corners, and settle on the ground. It's a choking physical presence that can move and change in intensity.

While the story's general structure is the same as before, the maps for each major location have been completely redesigned. All of the key features are still in there, somewhere, but appropriately it plays like a hazy recollection of the original, with snatches of the familiar transformed into something very much new and different.

Close range combat is scrappy and frantic. Technically, it's also very simplistic – just keep smashing the attack button until they fall over – but when we're talking about a desperate man trying to fight off unknowable, hideous entities with whatever he has to hand, an elegant, complex system doesn't necessarily sound like a good fit. Basic, violent clobbering makes a lot more sense.

When it's good it's excellent: any game that hews as closely as this one does to something with *Silent Hill 2*'s high standards can go toe to toe with any other modern horror game. But it relies too much on its repetitive, violent encounters, and I just wish it had been a little more careful to capture the spirit, as well as the look, of the original.

VERDICT

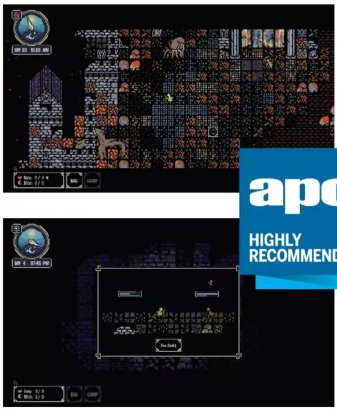
★★★★½

Bloober Team's take on Konami's *Silent Hill 2* is a fun but flawed take on a flawless gem.

Kerry Brunskill

1 It's nice to feel welcome in a new town.
2 A lot of old puzzles return with fun new twists.

2
James: I shouldn't have come here.



apc
HIGHLY RECOMMENDED

PRICE Free **PLATFORM** PC
WEB bit.ly/TravellersHymn

TRAVELLER'S HYMN

LESS HARD AND MORE COR.

In the wake of *Moonring and Skald: Against the Black Priory*, here's another vaguely Ultima-esque top-down RPG with a beautiful tileset and some modern bells and whistles. Where you could lose yourself in *Moonring*'s systems and lore, *Traveller's Hymn* is a smaller, more streamlined affair. It's a comfortable stomp round an autumnal forest where you're unlikely to trip over a hidden branch or lose your way among the trees for too long.

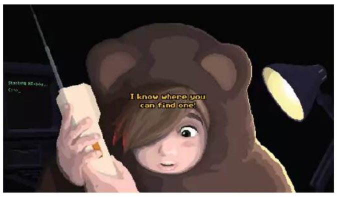
You explore the world by hopping from one tile to the next, and when you make contact with an enemy there's a pop-up battle. Your character stands on the left, and one enemy stands politely to the right, trading blows automatically until someone is defeated. The stats are taken into account, along with health bars that are pretty difficult to refill. As you find or buy new weapons and armour, you'll gradually rise to the top of the heap in this mid-sized, spooky but cosy world. All you need is your mouse, a sense of curiosity and some tolerance for ponderous exploration.

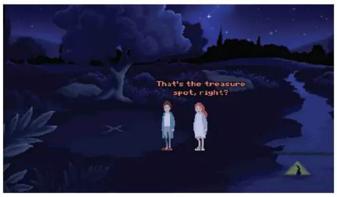
VERDICT

★★★★☆

A gorgeous, atmospheric RPG that focuses on exploration and discovery rather than builds and stats.

Tom Sykes





PRICE Free **PLATFORM** PC, Mac, Linux
WEB bit.ly/CampsiteGame

THE CAMPSITE

THREE KIDS HAVE A NIGHT TO REMEMBER.

Warm-hearted adventure game *The Campsite* has some of the best pixel art I've seen in, well, any game. The characters are expressively animated and the backgrounds are sumptuously drawn. You can understand why there are only a few of them, but a satisfying adventure nevertheless unfolds in this small, detailed space.

The adventure takes the form of a treasure hunt, where three kids liberate a classic car and head off into the jungle in search of the booty, and there are some lovely, not too tricky puzzles as you work your way to the conclusion. Many of them revolve around that car, as you manipulate its outside and interior to build your camp and ultimately access the dig site, and each solution is accompanied by more of that fluid animation, not to mention more fun banter between the children.

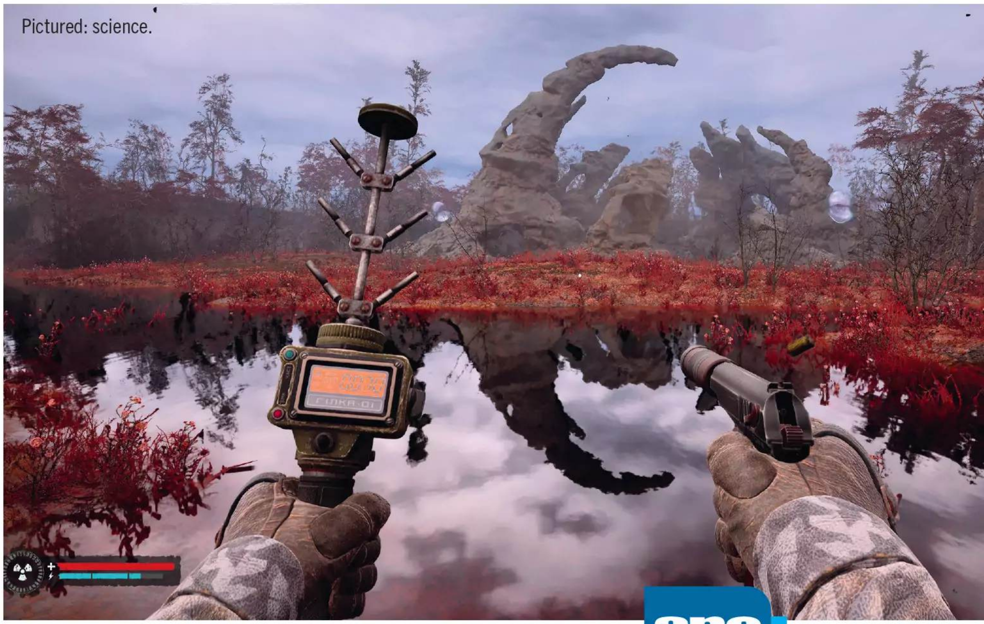
The Campsite delivers when you solve its puzzles and advance the story, though It can also be difficult to work out your objectives, with little dialogue or descriptive text to guide you along.

VERDICT

★★★☆☆

As I followed the story and where it was leading me, the more impressed I became.

Tom Sykes



Pictured: science.

apc HIGHLY RECOMMENDED

PRICE 102.50 **PLATFORM** PC, XBS/X **WEB** www.stalker2.com

STALKER 2

Beautiful, brilliant, but a bit busted.

It might be shinier and it might have gamepad support, but *STALKER 2* is still *STALKER* down to its bones, that unique and unreplicable mixture of FPS, survival horror and immersive sim. Whether X-Ray or UE5, the game's ambition still strains against the seams of its engine. It's still filled with systems – factions, artefacts, anomalies, a world filled with people going about their business and the staccato thuk-thuk of Eastern Bloc weaponry – that at times push the whole thing to breaking point and beyond it.

It's excellent, and undoubtedly my personal game of the year, though there were errors, crashes, progress-halting bugs and at-times hilarious glitches in animation and AI, plus minor stuttering that I just came to accept as the price of admission.

STALKER has always, quietly, had one of the stranger and more philosophical stories in the videogame narrative pantheon, and boy does *STALKER 2* make good on that legacy. It doesn't so much have a plot as it has a series of small ones in sequence that all eventually add up, each taking you to some new part of the astonishingly massive Zone map, which encompasses, so far as I can tell, every location featured in previous games and then some.

Maybe he wants to be friends.

Exploration feels never-ending, as do the two-kilometre sprints every time the game sets down a new quest marker that seems almost spitefully far away. *STALKER 2* does not hold your hand and the Zone does not care about you.

But as a *STALKER* die-hard even the bugs feel a bit like an old friend. It's these idiosyncrasies – the quirky, unforgiving, systems-driven game design and, yes, even the jank, that I worried GSC might be tempted to sacrifice in the leap to whatever AAA means.

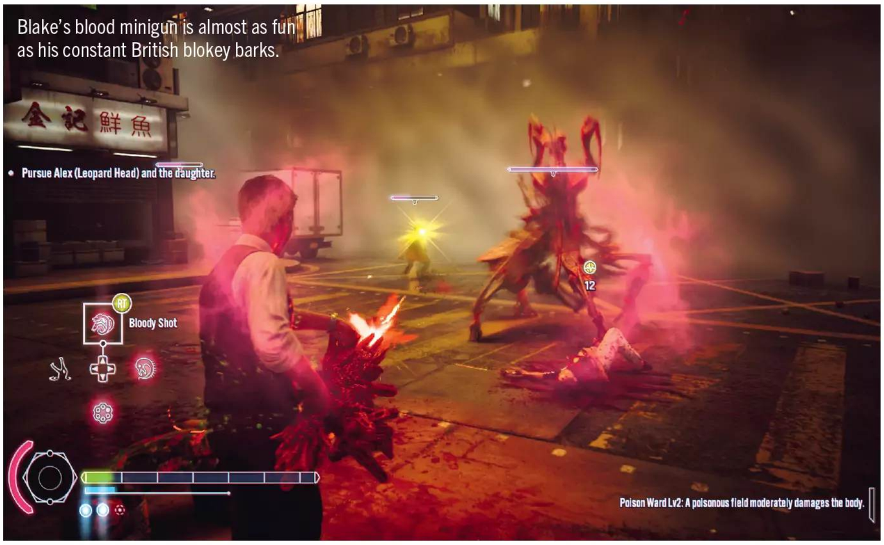
It's almost uncanny to play something with such unsentimental, old-school design sensibilities that looks as good and feels as modern as *STALKER 2* does, and it's a welcome return for one of PC gaming's greatest and most eccentric series.

VERDICT

★★★★☆

Performance issues and bugs don't stop *STALKER*'s mad, wonderful heart from shining through.

Joshua Wolens


金記鮮魚
Pursue Alex (Leopard Head) and the daughter.
RT
Bloody Shot
12
Poison Ward Lv2: A poisonous field moderately damages the body.

Blake's blood minigun is almost as fun as his constant British blokey barks.

PRICE $74.87 **PLATFORM** PC, PS4/5, XBS/X **WEB** tinyurl.com/APC542slitt

Slitterhead

Absurd bloodsoaked melodrama.

From the creator of *Silent Hill* and *Forbidden Siren* comes a game that spits in the eye of survival horror. *Slitterhead* is a bloody ridiculous action slaughterhouse. You play a mysterious floating entity with no memories (of course) who can possess almost any NPC in the game. You spend your initial moments bouncing between bodies until someone down a dark alley greets you with their head exploding, revealing your first *Slitterhead*.

Luckily, you can fight back with any NPC you possess, and you're encouraged to constantly hop between civilians with a brief damage bonus each time you do. But if you die three times before escaping your host body, it's game over. *Slitterhead* is no open world game, but its large NPC-packed levels are still a great showcase for this impressive body-hopping tech. Whacking a *Slitterhead* in the back, watching it turn its understandably-angry attention onto you, then leaping into another body behind it and hitting it in the back again is a delightfully cheap treat. NPCs can also lob a sort-of blood grenade, though ripping vital fluids out of your own body understandably comes with a steep health cost.

Outside of the ferocious core combat, however, the game struggles. Chase sequences, where you jump between bodies to make up the distance and keep firing attacks like poison darts to wear your target down, can be exhilarating. The problem starts with the blood jump. These huge leaps into the sky are completely context-sensitive, a tiresome bit of game design I really can't wait to go extinct. There's skill points and optional boss battles to find, but this just feels like unnecessary padding in a game that could've easily lost a few hours anyway. But it's still a stylish joyously-daft playable B-movie with a great central body-hopping idea, and I'd be first in line for a sequel that finds more creative uses for it. Until then, a goofy action bloodbath will more than suffice.

VERDICT

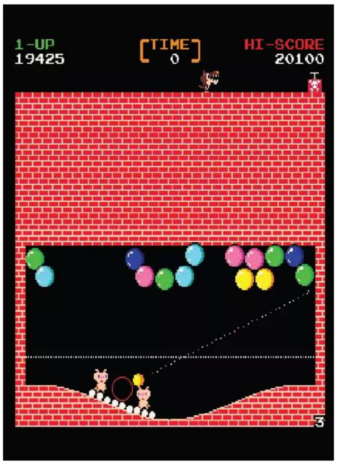
★★★☆☆

Bokeh Game Studio Inc's *Slitterhead* is a fun but flawed slaughterfest with a great NPC-possession hook.

Abbie Stone

1 The first *Slitterhead* you meet down a dark alley. H-hi there!

2 You'll meet a cult of *Slitterheads* and people living in harmony. Um… good luck!



PRICE Free **PLATFORM** PC
WEB bit.ly/BalloonJerks

BALLOON JERKS

PUZZLE BOBBLE BUT WITH PIGS.

Puzzle Bobble is my favourite match-three game, so it's great to find an indie game that builds on the concept, adding further ingredients to the formula until it's popping with freshness once again. *Balloon Jerks* has you playing as a couple of pigs whose balloon-bursting fun is ruined by annoying wolves.

As you punt balloons up into the screen, clearing clutches, the wolves will add to the mess by floating upwards on their own balloons. There's an adorable animation as they deposit the balloon and then parachute to the ground, and an even cuter one when you interrupt their fun by shooting them out of the sky. Visual flair aside, it's also a clever mechanic that keeps you permanently on your trotters by adding little bursts of time pressure.

The standard *Puzzle Bobble* ball-matching is quickly embellished with other ideas, including the bottom of the screen being flooded with water and Wildcard Balloons that cycle through every colour. There's even a separate mode where you bounce the pigs off a see-saw.

VERDICT

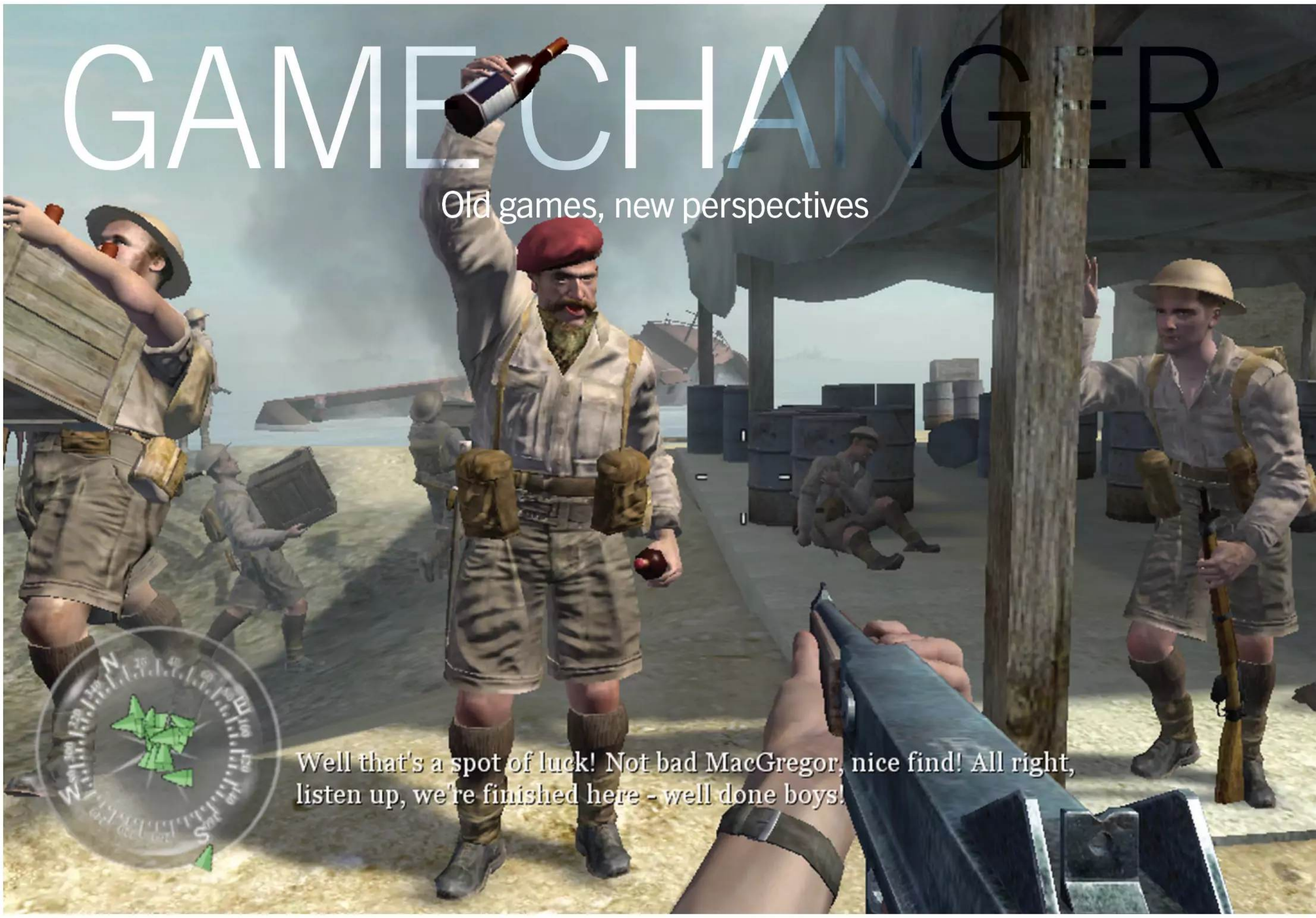
★★★½☆

Balloon Jerks is so fun that you'll surely want to return to it frequently.

Tom Sykes

GAME CHANGER

Old games, new perspectives



Well that's a spot of luck! Not bad MacGregor, nice find! All right, listen up, we're finished here - well done boys!

RELEASE 2005 **DEVELOPER** Infinity Ward **PUBLISHER** Activision **LINK** callofduty.com

Call of Duty 2

How Call of Duty felt before Modern Warfare. By Kyle Hoekstra.

It's 2005 and I'm strapped into the back of a truck, driving once more into a North African town in the level The End of the Beginning in the demo for *Call of Duty 2*. Ahead, El Daba is masked by desert haze and a grave instrumental underscores the nervous energy of boys from the 7th Armoured Division. Suddenly fighter planes are swooping above, the tank ahead explodes along with the Tommies who were riding it, and your driver swerves to avoid the wreckage as it chugs smoke over the landscape.

This is the kind of non-interactive, bombastic spectacle which would define the series – not always to its credit. But here, as I replayed the demo yet again, I was impressed. When you leap from the truck you're plunged into a street fight. You push through alleys, which seemed more labyrinthine than they really were, and eliminate artillery crews before signalling the Allied fleet to bombard the docks.

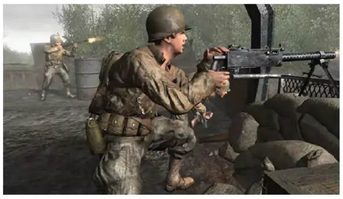
Drama is injected at every opportunity: on the way to grab some final intel, a Tommy busts through a door only to be torn apart by a machine gun. Sometimes the drama isn't scripted: I step onto a backstreet, where I witness an enemy beaten down by an ally who I'm convinced would burn with fury even if it wasn't programmed, and suddenly my role as player feels important only as part of a greater war effort.

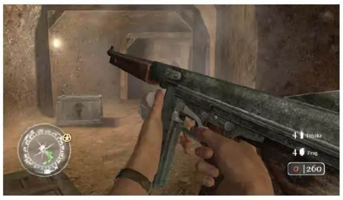
I was used to the absurdity of arena shooters. By contrast, *Call of Duty 2* offered immersive, straight-faced spectacle, leaving out pickups and health packs for narrative set pieces which eclipsed its predecessors. Infinity Ward's status was cemented among shooter devs on PC, and as a console exclusive on Xbox 360 it also helped reinforce its shooter credentials.

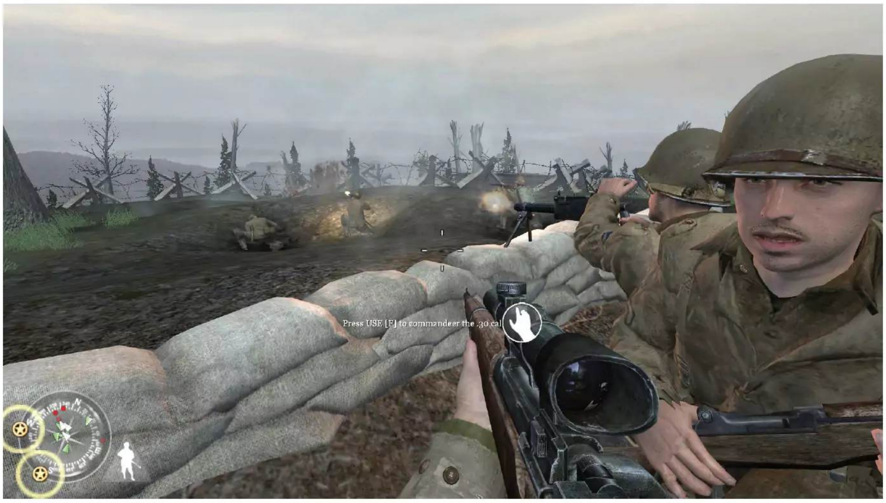
When *Call of Duty 4: Modern Warfare* swept the board with its inventive campaign and multiplayer, *Call of Duty 2*'s sincerity instantly looked a bit old hat. By this time Activision's multi-developer, multiplatform *CoD* machine was steaming ahead. Yet while many of its franchise kin proved forgettable, *Call of Duty 2* remains every bit the thrill-ride that Infinity Ward promised it would be.

Moments of cinema

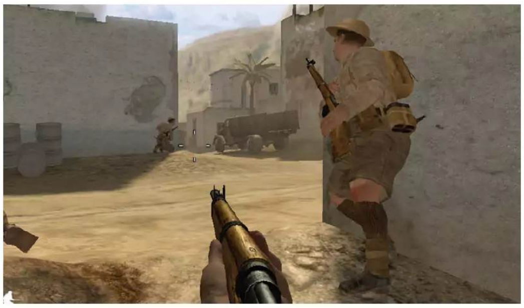
When I finally installed the game from its fresh DVD-ROM, it turned out my war would begin in Moscow. It starts like every World War II game from those days: basic training, albeit this time with potatoes instead of grenades. Thereafter the Stalingrad campaign unfolds with missions kicking off with moments of cinema. On your way to reinforce embattled Russian comrades, you navigate darkened corridors while echoing megaphones demand your surrender. You

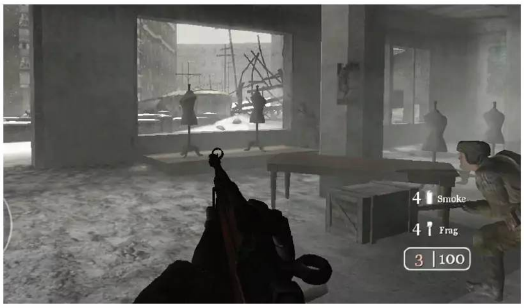






ABOVE: The reloading animations are a nice way to show off the devs' handiwork.





RIGHT: The game gave the impression of a squad shooter, even when you know it isn't.

hunker down in a trench as tanks rumble overhead. As you attempt to crawl surreptitiously through a pipe into a train yard, gunfire bores rays of light through the metal.

The singleplayer is divided into three campaigns, the other two following British Desert Rats in North Africa and France and American Rangers in Western Europe. Some levels are conventionally tight and scripted, others expansive and less controlled. But above all *Call of Duty 2* sold drama. By the time you're enacting a close-quarters raid on a fuel depot as Sergeant John Davies in Egypt, you've already hunted panzers in Stalingrad as Private Vasili Koslov and feverishly repulsed waves of Wehrmacht from its City Hall by sniping across a square.

As the Brits in Africa, you defend a town by spotting far-away targets for artillery with binoculars and plod beside a tank and clear out bunkers. In a tense escape mission you take the gunner's seat in a commandeered armoured car as Captain Price and Private McGregor bicker while wheeling past half-tracks and anti-tank troops.

Unexpected turn

In an unexpected turn, you're given the command of a tank in an engaging vehicular puzzle which works surprisingly well to mix up the pace. It begins with a *Star Wars*-like reporting-in ("Zebra One ready!"), then dives into a tank rush with a real sense of momentum. You hunt your quarry across sand dunes beneath a golden horizon, where tanks erupt in delightful plumes.

But the most memorable set piece in *Call of Duty 2* is the D-Day mission. There's not a moment of silence in this intense retread of an event explored by a proto-Infinity Ward in *Medal of Honor: Allied Assault*. Soldiers perish under gunfire and topple from rope ladders beneath the sheer cliffs of Pointe du Hoc.

At the top, trenches lead to an orchard with artillery to be

CALL TIME

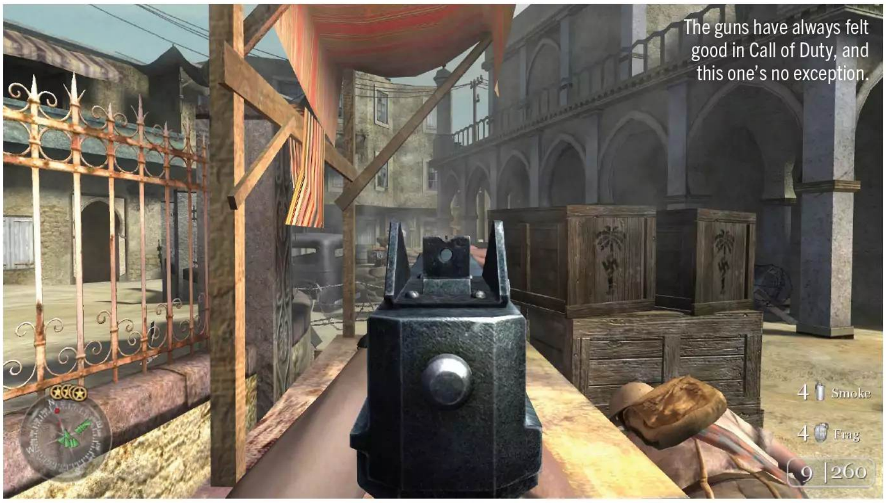
Infinity Ward's CoDs in the 2000s

CALL OF DUTY
2003
The minds behind *Medal of Honor: Allied Assault* released their debut to great acclaim, racking up 80 Game of the Year awards.

CALL OF DUTY 2
2005
Infinity Ward's sequel continued to push the envelope for immersive World War II games, before they left the period for good.

CALL OF DUTY 4: MODERN WARFARE
2007
Set in the present day, the series' destiny changed instantly with *Modern Warfare*'s massive success.

CALL OF DUTY: MODERN WARFARE 2
2009
The worthy sequel to *Modern Warfare* was the last before two studio leads left to form Respawn Entertainment.



The guns have always felt good in Call of Duty, and this one's no exception.

FAR LEFT: With *Call of Duty 2* Infinity Ward gave the best version of *Saving Private Ryan*: the game.

ABOVE: Disappointingly, it does not flush.

sabotaged. The sound is carnage. Thompsons and BARs rattle against the hum of an MG in a punched-out eve. The staccato pops of rifles and 'zing' of ejected Garand clips intermingle with American and German yelling. Bombs whistle and crash, walls light up with gunfire and wisps of smoke attend bullet holes. The war-torn landscape may look distinctly polygonal nowadays, but it never feels less than exciting.

Once the artillery's dealt with, the level is played in reverse as you refight across the orchard to clear the bunkers. Ultimately, the mood switches to one of desperation, with you clinging onto the Pointe until air support can save the day. The sense of release when they do is heightened immeasurably by playing on Veteran difficulty – a thoroughly punishing grind. This is *Call of Duty 2* at its peak.

Head-popping

There were World War II games before this, but had they ever felt so electrifying? Its weapons sounded punchy and realistic. They came with smooth reloading animations which showed off accurate models and reinforced the sense that you were embodying someone super-competent, a fantasy (let's be honest) elaborated with each sequel with greater fidelity.

Lots of the game is seen through iron-sights and it can feel like an exercise in head-popping, but no less than its sequels. Targets are squishy, and unloading a Thompson makes you feel like a gangster. Unlike its sequels you can't throw back grenades and you can't sprint. But it did introduce smoke grenades, which spread effectively and confuse enemies so you can move unseen to the next slab of waist-high cover.

Unlike the original, *Call of Duty 2*'s levels fan out into more open spaces. This required rebuilding the AI, so they could respond to player attempts on the objective from various angles.

Band of brothers

Two valiant comrades clamber on a panzer and lob a grenade through its top hatch. They leap off, but kind of can't, and then soar off into the snow as they explode with the tank.

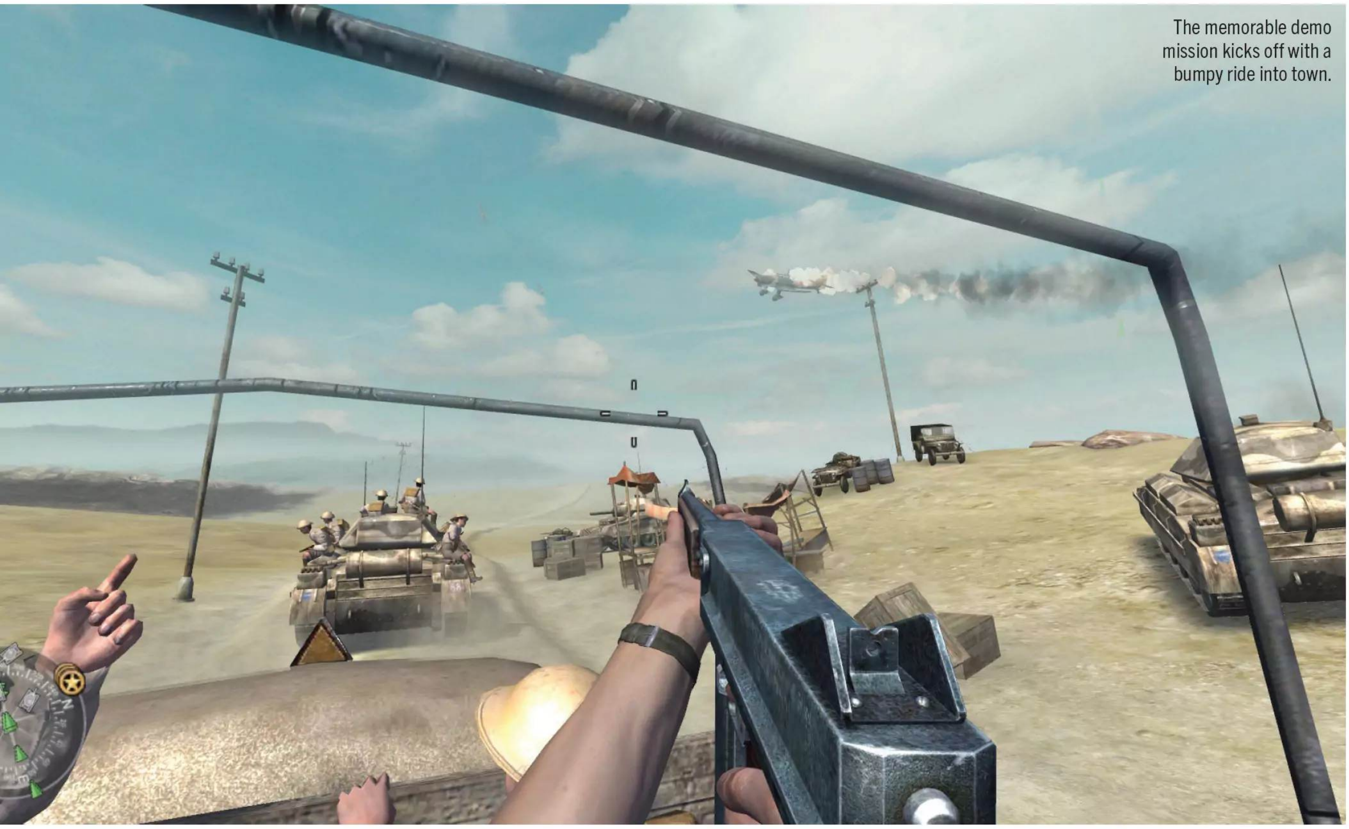
WAR VETERAN

The most challenging missions on Veteran

THE SILO
Even after you've torturously cleared each of the marked houses in this bucolic village, you're charged with sniping mortar teams from above a silo before they get you first.

BATTLE FOR HILL 400
A gruelling uphill fight transitions into a defence of a bunker on top of a hill, where you have to take cover from artillery, snipe baddies and hold out for help.

COMRADE SNIPER
Staying behind cover to pick off waves of enemies is tricky when your comrades have a laissez-faire approach to covering your back. Make those bullets count.



The memorable demo mission kicks off with a bumpy ride into town.

Nobody's going to claim these guys are sentient, but in other moments *Call of Duty 2*'s soldiers helped make you feel like part of a squad.

Despite their routine death by silliness, these voiced squad mates are memorable. That squad feeling is mainly accomplished with a "battle chatter" system which bestows a rough situational awareness to its AI.

It isn't a squad tactics game, but you want to believe it is when you hear allies attempting to cut through the confusion of battle and coordinate your attention. They'll point out targets with precise coordinates including, "Fascists! Behind the low wall, over to the south!" and, "Krauts! By the sandbags!" as well as the 20,000 other lines of dialogue of that flavour which were recorded.

Ramping the difficulty up to Veteran sharply exposes the foibles of the AI. Enemies' gunfire is dead-on and their massed grenades are extremely annoying. They're idiots to code: in practice it is difficult to get the drop on them. Like Agents Smith they'll swivel as one and fire with unerring accuracy.

It is cheering when comrades rush forwards autonomously, dropping foes and yelling military garble. But when they stop advancing, because you have not tripped an invisible logic switch which will force them onwards, missions can grind to a halt. As a result a lot of Veteran is spent trying to usher allies onwards where they'll face enemies so you don't have to. All the same, you never feel like you're fighting alone like you do in, say, *Halo*. The texture standards of the time even let me imagine that Sgt Randall's cuboid head disguised the face of Tom Hanks' Captain Miller.

Curtain call

The blurb on the back of the box promises "more cinematic intensity and chaos than ever before". On this note, 2024's *Call of Duty: Black Ops 6* has the edge, its singleplayer unfurling a breathless, genre-blending rollercoaster. But beside it, *Call of Duty 2* isn't embarrassed.

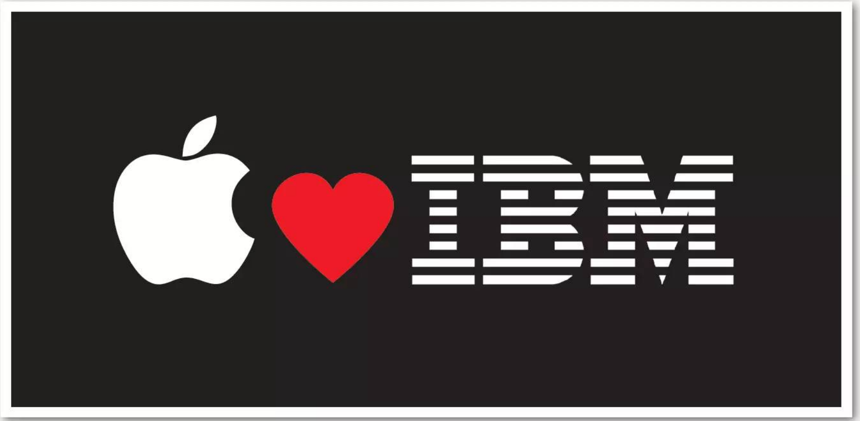
It may be slower, and not just because you can't sprint. It's a little more composed and sober, yet still exhibits the set pieces that came to be the series' trademark. It shores up some gravitas from its use of Military Channel footage, photo slides to foreground missions, and the inclusion of journal entries from its otherwise inscrutable protagonists. This gives it the feeling of a history piece. Meanwhile the self-serious score by Graeme Revelle and the stately quotes from generals which appear when you die give it a solemn atmosphere.

On the other hand there's something about its clarity of visuals which make it enjoyable to return to. The magnificent TV series *Band of Brothers* convinced Epic to desaturate the look of 2006's *Gears of War* and a host of games followed suit, including 2008's *Call of Duty: World at War*. But *Call of Duty 2* still aims to please with its blue skies and golden sandstone towns and lush Normandy bocage.

Altogether, *Call of Duty 2* survived as more than just an artefact. Battling with the game even on the highest difficulty until the relief of "Checkpoint Reached" remains a thrill ride. ■

RETRO

Inspirational stories from computing's long-distant past



The alliance between Apple and IBM was intended to create a single unifying platform.

Apple's big blues

Apple once joined forces with IBM to create a new operating system that could easily have destroyed the Mac. David Crookes explains what happened.

In the late 1980s, Apple embarked on one of its most ambitious software projects: the creation of a next-generation operating system, codenamed Pink. Presented on a pink index card (hence the name), it was the brainchild of a small group of Apple engineers who believed the Mac needed memory protection to safeguard users' work in the event of a system crash. This innovation also helped to pave the way for an alliance with IBM that had the potential to revolutionise computing forever.

Around 1988, the Mac was experiencing a period of flux. Launched in January 1984, it had initially achieved success but most of the computer's original team members, including Steve Jobs, had dispersed and cracks were beginning to appear. While improvements had been made to the Mac line-up, such as the introduction of colour graphics in the Macintosh II in 1987, it became clear that a new operating system was necessary to replace Macintosh System Software sooner rather than later.

"The classic Mac OS was increasingly difficult to work with," said Mark Davis, who would become the manager and architect for the proposed operating system's international frameworks. "The original Mac had such constraints of speed and size that the OS was written all by hand in assembly, and the structure was very difficult to maintain and extend."

Initially, only five people worked on Pink – the so-called Gang of Five who had proposed it. Project leader Erich Ringewald was joined by David Goldsmith, Bayles Holt, Gene Pope and Gerard Schutten. This small team had also presented two additional sets of goals for consideration, each represented on a different coloured index card. Red proposed an operating system with far more advanced features such as speech recognition, while Blue concentrated on short-term achievements that could be integrated into the Mac.

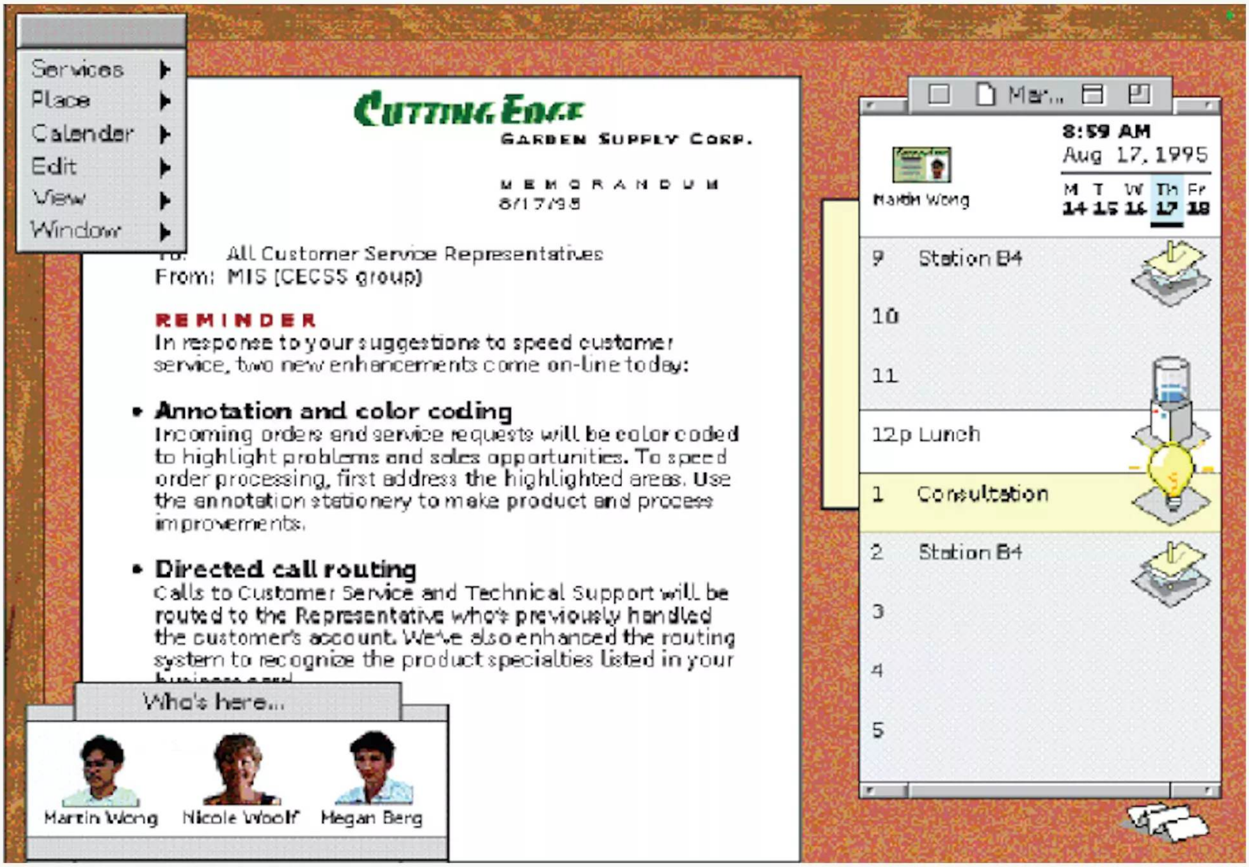
Pink, however, stood out as the most significant development since it was forward looking and achievable, especially since the OS was being developed during a period when Microsoft Windows was enhancing its capabilities and IBM had launched a promising competitor called OS/2. "Pink had the promise of leapfrogging Macintosh System Software, Windows and OS/2," said Davis, who stressed the software was created 30 years ago.

All systems go

When the engineers began work in March 1988, their key priorities were memory protection and multitasking, with the OS set to be built using legacy System 6 code. Within a few weeks, Pink evolved into an object-oriented operating system written in C++, which was a relatively novel concept at the time. This approach made the OS more adaptable, future-proof and easier to update, manage and build upon.

Moreover, the engineers believed it would make life easier for app developers, encouraging them to create more software for Apple computers. But it was also clear that the task of creating the new OS was

> "Pink evolved into an object-oriented operating system written in C++, which was a relatively novel concept at the time."



CUTTING EDGE
GARDEN SUPPLY CORP.

MEMORANDUM
8/17/95

To: All Customer Service Representatives
From: MIS (CECSS group)

REMINDER
In response to your suggestions to speed customer service, two new enhancements come on-line today:

- **Annotation and color coding**
  Incoming orders and service requests will be color coded to highlight problems and sales opportunities. To speed order processing, first address the highlighted areas. Use the annotation stationery to make product and process improvements.
- **Directed call routing**
  Calls to Customer Service and Technical Support will be routed to the Representative who's previously handled the customer's account. We've also enhanced the routing system to recognize the product specialties listed in your

ABOVE There are very few screens showing the Pink/ Taligent OS.

going to overwhelm a five-person team. Recognising this, a separate team was assembled to create a kernel that would provide memory protection and prevent crashes. Within a couple of months, 25 people had joined the Pink project. But this influx of talent also brought new challenges.

By October, Ringewald, Pope and Shutten already felt the project was spiralling out of control and they left, concerned their goals wouldn't be accomplished. But Apple believed that Pink had the potential to have a positive impact on the company, so investment continued and the features continued to stack up.

"Off the top of my head, Pink had modern frameworks, a powerful graphics system and it was fully Unicode/internationalised," Davis said. Yet when anyone asked when Pink was due to be released, the answer consistently seemed to be "two years".

Another bite

By 1990, 150 people were working on Pink, either directly or as support staff. A marketing team was even in place, despite the operating system remaining far from completion. By this point, Pink was going to replace the Mac operating system rather than enhance it – its growth had made a fresh start inevitable.

"In order to make that happen – while maintaining the classic Mac OS during the Pink development and deployment – Apple needed partners," Davis said.

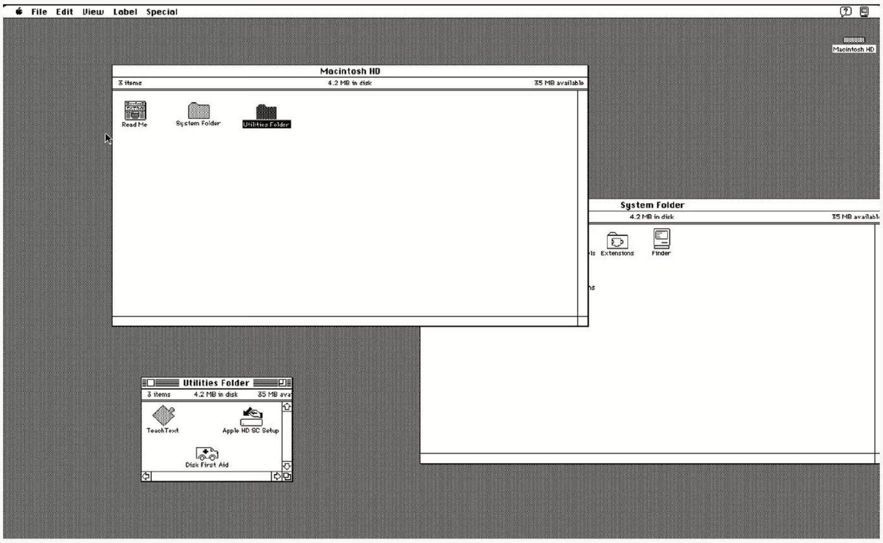
External assistance came in the form of IBM. In the second half of 1991, Apple and IBM formalised an alliance that executives told the *New York Times* would "change the landscape of computing in the 90s". Its primary aim was to "use common chips and common software in an effort to gain control of two key technologies," the report continued.

The Apple-IBM alliance went beyond simply assisting with Pink. Both companies would collaborate on developing RISC technology for a new PowerPC microprocessor with assistance from Motorola (Apple insisted the latter was brought on board so it wouldn't be reliant on IBM for processors). They would also work together on the development of multimedia and interface technologies in a partnership called Kaleida.

Pink would be subsumed into a new company called Taligent ("I was the head of the internationalisation and text group with the responsibility of making it easy to produce apps that could handle any language," Davis said).

The intention was to create a single unifying open-standard computing platform that could compete against the combined power of Microsoft and Intel. As part of the deal, Apple would become a prime customer for the new chips and IBM would benefit from Pink, which was also earmarked to work on Intel-powered computers.

With Apple's market share down by around 50% in the late 1980s as it competed against more affordable IBM-compatible PCs, the deal made sense. Allowing Pink – or Taligent or TalOS, as it was becoming known – to be used on other computers was also attractive. This strategy had proven successful for Microsoft, after all.


File
Edit
View
Label
Special
Macintosh HD
Macintosh HD
3 items
4.2 MB in disk
35 MB available
Read Me
System Folder
Utilities Folder
System Folder
4.2 MB in disk
35 MB availabl
Extensions
Finder
Utilities Folder
3 items
4.2 MB in disk
35 MB ava
TeachText
Apple HD SC Setup
Disk First Aid

TOP: The Taligent HQ on the Apple Infinite Loop Campus, Cupertino. **ABOVE** Apple's successful System 7 OS was based on the Blue goals.

> "Apple would become a prime customer for the new chips and IBM would benefit from Pink."

Seeing stars

Pink had made significant progress by this stage. Apple's CEO John Sculley said more than 1.5 million lines of code had been written, indicating that it wasn't that far from completion. "As I recall, it was fairly far along at that point," Davis agreed, although he admits his memory of Pink's transition to Taligent is "very fuzzy".

The Taligent reins were handed to an IBM person – Joe Guglielmi, who was previously the general manager of marketing and business development for the company's Personal Systems Line of Business. He believed in the future importance of object-oriented technology and he told IBM OS/2 *Developer* magazine that "since we're writing an operating system from scratch, we get to do some things right".

But in 1993, there was a change in strategy. "Initially, the notion was to deliver one large, brand new operating system, top to bottom, in one really significant drop," Guglielmi said. "We've become more realistic about that; we've had to deal with very pragmatic issues." Rather than release a single OS, those working on Taligent looked to take pieces of their operating system and make them available to others such as IBM's OS/2 and AIX and Macintosh System Software.

"This isn't 1983 any more," Guglielmi said. "This isn't about 'I have a great technology; we'll just get people to stop what they're doing and move over to it'. We have example after example in the marketplace today where great technology can't get commercial acceptance."

It seemed rather unorthodox – to help make other operating systems competitive through evolution so that introducing Taligent as a whole wouldn't be a big step up. But it ensured there was still some life left in Windows' current crop of rivals; which was just as well because, while work continued at Taligent, Apple shipped System 7, created by a team that had been following the Blue goals laid out three years earlier.

The latest release of the classic Mac OS operating system included QuickTime, virtual memory, drag-and-drop, TrueType fonts, a Force Quit dialog, balloon help and personal file sharing. It was two years behind schedule (the initial work having only been envisaged to take a year), but it was very impressive, giving Microsoft a run for its money until the launch of Windows 95.

The Mac killer?

Apple had hoped IBM would shoulder a significant portion of the costs associated with developing Taligent. But the persistent issues that plagued Pink, particularly a lack of focus, were damaging Taligent. Some 350 people were employed at Taligent a year after its formation, a substantial increase from 160, and that was causing problems.

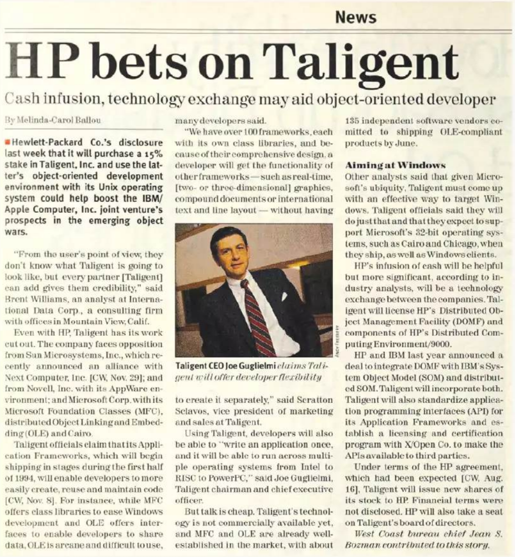
"I think the biggest challenge in hindsight was managing the project, keeping it from being forever in development," Davis said. "One policy had a horrible impact; people working at lower levels of the project would make incompatible changes and it was up to everyone else on the project to rewrite their code."

In one sense, Taligent's ongoing drama was working in Apple's favour. In 1993, an article in *Wired* magazine discussed the wider implications of a successful Taligent, claiming it would effectively kill both the Mac and IBM's OS/2. If the new operating would work across different computers, whether PowerPC or Intel-based, what would be the attraction of the Mac?

"Realising that the Macintosh can never prevail against the dominance of Intel-architecture systems, Apple is gradually phasing out the Mac," the article said, pointing out that 92% of large corporations were intending to use the Pentium and 486 chips manufactured by Intel.

Taligent had the potential to supplant Windows whereas Apple's own OS did not – indeed, an attempt to port Macintosh System 7 to Intel-compatible PCs (the Star Trek project) had just been canned after a year in development. But the longer it took for Taligent to be developed, the more disinterested the wider computing world was becoming. And this, in some ways, saved the Mac.

In fact, Apple's alliance with IBM required it to develop future ranges fitted with PowerPC chips, but these wouldn't be compatible with the Mac's operating system as it was. So Apple released System 7.1.2 in 1994 – the first Mac system software for Power Macs – and the PowerPC range continued until 2006.



News

HP bets on Taligent

Cash infusion, technology exchange may aid object-oriented developer

By Melinda-Carol Ballou

Hewlett-Packard Co.'s disclosure last week that it will purchase a 15% stake in Taligent, Inc. and use the latter's object-oriented development environment with its Unix operating system could help boost the IBM/Apple Computer, Inc. joint venture's prospects in the emerging object wars.

"From the user's point of view, they don't know what Taligent is going to look like, but every partner [Taligent] can add gives them credibility," said Brent Williams, an analyst at International Data Corp., a consulting firm with offices in Mountain View, Calif.

Even with HP, Taligent has its work cut out. The company faces opposition from Sun Microsystems, Inc., which recently announced an alliance with Next Computer, Inc. [CW, Nov. 29]; and from Novell, Inc. with its AppWare environment; and Microsoft Corp. with its Microsoft Foundation Classes (MFC), distributed Object Linking and Embedding (OLE) and Cairo.

Taligent officials claim that its Application Frameworks, which will begin shipping in stages during the first half of 1994, will enable developers to more easily create, reuse and maintain code [CW, Nov. 8]. For instance, while MFC offers class libraries to ease Windows development and OLE offers interfaces to enable developers to share data, OLE is arcane and difficult to use, many developers said.

"We have over 100 frameworks, each with its own class libraries, and because of their comprehensive design, a developer will get the functionality of other frameworks — such as real-time, [two- or three-dimensional] graphics, compound documents or international text and line layout — without having to create it separately," said Scratton Sclavos, vice president of marketing and sales at Taligent.

Taligent CEO Joe Guglielmi *claims Taligent will offer developer flexibility*

Using Taligent, developers will also be able to "write an application once, and it will be able to run across multiple operating systems from Intel to RISC to PowerPC," said Joe Guglielmi, Taligent chairman and chief executive officer.

But talk is cheap. Taligent's technology is not commercially available yet, and MFC and OLE are already well-established in the market, with about 135 independent software vendors comitted to shipping OLE-compliant products by June.

Aiming at Windows

Other analysts said that given Microsoft's ubiquity, Taligent must come up with an effective way to target Windows. Taligent officials said they will do just that and that they expect to support Microsoft's 32-bit operating systems, such as Cairo and Chicago, when they ship, as well as Windows clients.

HP's infusion of cash will be helpful but more significant, according to industry analysts, will be a technology exchange between the companies. Taligent will license HP's Distributed Object Management Facility (DOMF) and components of HP's Distributed Computing Environment/9000.

HP and IBM last year announced a deal to integrate DOMF with IBM's System Object Model (SOM) and distributed SOM. Taligent will incorporate both. Taligent will also standardize application programming interfaces (API) for its Application Frameworks and establish a licensing and certification program with X/Open Co. to make the APIs available to third parties.

Under terms of the HP agreement, which had been expected [CW, Aug. 16], Taligent will issue new shares of its stock to HP. Financial terms were not disclosed. HP will also take a seat on Taligent's board of directors.

West Coast bureau chief Jean S. Bozman contributed to this story.

A brighter future

Still, Taligent had clung on for some time. Hewlett-Packard bought a 15% stake in Taligent in 1994, adding credibility, yet more and more users appeared happy backing Windows 3 and Windows 95. As the months rolled by, Taligent seemed less likely to succeed.

"Joe Guglielmi left suddenly [in September 1995] and his replacement Dick Gurino died suddenly very shortly thereafter," said Davis. "It all unravelled as a joint venture thereafter."

It certainly did. In December 1995, Apple cut its losses and dissolved the project. As a result, half of Taligent's 400 staff were made redundant and Taligent formally ended in 1998.

IBM absorbed most of Taligent's assets and integrated some of its innovations into its own software. Notably, parts of the OS were used in IBM's Workplace OS prototype, and a layer called CommonPoint made up of more than 100 object-oriented frameworks was released. It lay on top of operating systems such as OS/2, AIX, HP-UX and Windows NT.

"Although Taligent was ahead of its time in terms of design and capabilities, it was also ahead of its time in terms of hardware requirements – too far ahead," Davis said.

And yet that proved to be blessing. Had the Taligent part of the alliance worked out, there was a good chance IBM would have taken over Apple. As detailed in the 1997 book, Apple: The Inside Story of Intrigue, Egomania and Business Blunders, the two companies were looking to see how well they worked together and a potential deal was on the cards.

Sculley believed Apple needed a company to acquire it because he couldn't see how it could continue alone. Had a takeover happened, it would have created a force to be reckoned with but, with hindsight, the consequences would have been profound.

Jobs is unlikely to have returned to Apple, bringing with him the NeXTSTEP operating system which formed the basis for the future of Mac OS and in effect saved the company. Apple's subsequent rise is also unlikely to have happened, and there's a strong chance we wouldn't be holding an iPhone or iPad today unless Jobs had taken his talent elsewhere.

So while the collapse of the Taligent side of the IBM deal wasn't ideal, it worked out for the best. And the alliance did have an impact. Its legacy included the push towards reusable, modular code and the development of the PowerPC CPU architecture. With both Apple and IBM also in great health today, there can surely be no real regrets. ■

ABOVE Taligent attracted much press coverage in publications such as *Computerworld*.

BELOW The alliance helped lead to the development of the PowerPC CPU architecture.

Pippinitis, apple.fandom.com/wiki/Taligent

KNOW HOW

Seeking a free way to watch videos offline on the train, Robert Irvine tries to…

Download YouTube videos on his phone

If I could travel back in time – just like Marty McFly – I think I'd jump back 20 years and launch my own version of YouTube. The video-sharing service was founded in February 2005, which would give me two months to steal its thunder.

YouTube must have one of the most ingenious business models in history. Invite everyone to upload their videos for free, then earn money from other people's work by making viewers sit through adverts. Keep showing more and more ads, then launch an expensive Premium subscription that generates further revenue by offering ad-free streaming. Ker-ching!

I realise it's not quite that cynical, and that YouTube 'creators' can profit from their original content. But I still get annoyed that I can't download videos to watch on my phone without paying $17 a month for YouTube Premium. Trying to stream clips while travelling by train, for example, leaves me at the mercy of the flaky on-board Wi-Fi and my even flakier 4G/5G signal.

With a few long rail journeys planned over Christmas, I wondered if there was a way to beat the download restriction and avoid buffering frustration. One option was 4K Video Downloader for Android, which was recently updated "to make downloading your favourite videos even smoother" (see **tinyurl.com/APC542vid**).

It's not available from the Google Play Store, which bans YouTube downloaders (for business reasons), so instead I had to sideload it on my phone. To do so, I visited the app's web page (**tinyurl.com/APC542vidchrome**) in the Chrome mobile browser and pressed the Get 4K Video Downloader button.

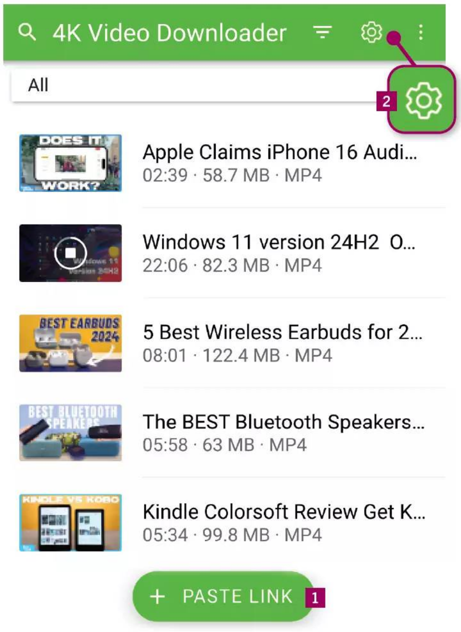
This downloaded the APK file to my phone's Downloads folder, where I opened it and received a warning about installing apps from unknown sources. I went into Settings, switched on 'Allow from this source' and tapped Install. I then launched 4K Video Downloader and granted it permission to access media files on my device.

The app's interface was so impressively simple – with its big green Paste Link button (1 in our screenshot) – that even I could figure out. I copied a link from YouTube by tapping the Share button below the video and pasted it into 4K Video Downloader.

To my delight, it downloaded instantly in MP4 format, with no need to configure any settings – you can press the cog in the top-right corner 2 to change the default resolution. I tapped the video to watch it in my phone's media player, which worked even when I disconnected from my Wi-Fi and mobile network so I could confirm the clip was truly offline.

I downloaded four more videos, but I then hit a snag. The free version of 4K Video Downloader limits you to downloading five videos a day, after which you need to buy a licence. This costs a one-off fee of $10, which is still much cheaper than YouTube Premium.

Nonetheless, as I was short of cash in the run-up to Christmas, I sought a completely free solution. This came from NewPipe (**https://newpipe.net**), the free Android app that lets you watch YouTube videos without ads or trackers. As with 4K Video Downloader, this isn't available from the Google Play Store, so I downloaded it by visiting its mobile site and tapping Get NewPipe.



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4K Video Downloader for Android lets you download five videos per day for free.

Because I'd already given Chrome permission to install apps from unknown sources, setting up NewPipe was a breeze and I was able to search YouTube straight away. To download a video, I simply tapped the Download button below the player and selected a download folder.

So I now have two reliable methods for saving videos to watch offline, and didn't have to rely on Santa bringing me a YouTube Premium subscription. ■

> "YouTube must have one of the most ingenious business models in history. Invite everyone to upload their videos for free, then earn money from other people's work by making viewers sit through adverts."

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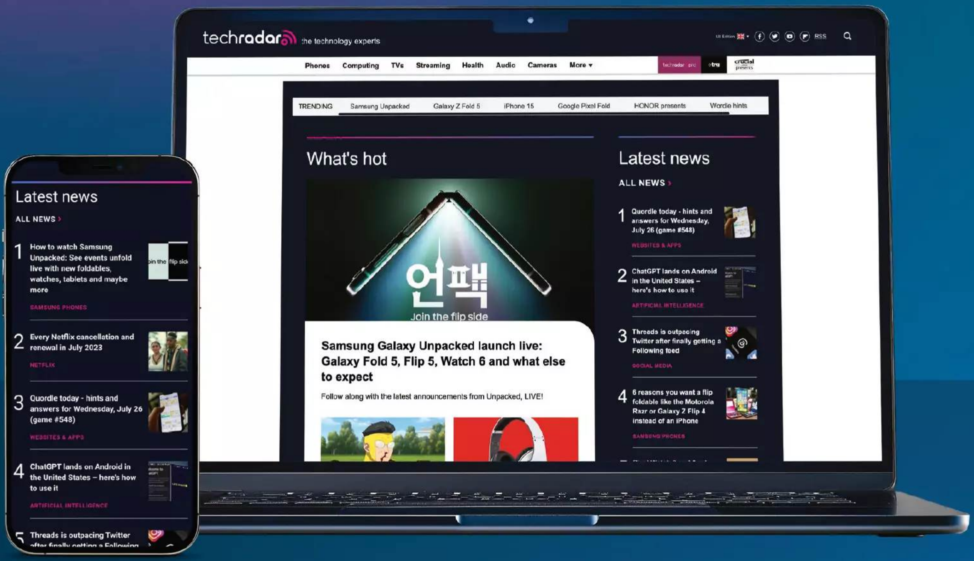
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